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LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; First Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 17–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eight Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29-30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1–3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

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Wilson, R. N., U. S. Bureau of Entomology, Tempe, Ariz.
Winslow, R. M., Department of Agriculture, Victoria, Canada.
Wolcott, G. N., U. S. Bureau of Entomology, Dallas, Texas.
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Young, D. B., State Museum, Albany, N. Y.
Zimmer, J. F., U. S. Bureau of Entomology, Washington, D. C.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.
Ballou, H. A., Imperial Department of Agriculture, Barbados, West Indies.
Berlese, Dr. Antonio, Reale Stazione di Entomologia Agraria, Firenze, Italy.
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Fuller, Claude, Department of Agricuture, Peitermaritzburg, Natal, South Africa.
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Lea, A. M., Department of Agriculture, Hobart, Tasmania.

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Reed, Charles S., Mendoza, Argentine Republic, South America.

Reuter, Dr. Enzio, Agrikultur-Enconomiska Försöksamstalten, Helsingfors, Finland.

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Proceedings of the Twenty-fifth Annual Meeting of the American Association of Economic Entomologists

The twenty-fifth annual meeting of the American Association of Economic Entomologists was held in the Normal School Building, Cleveland, Ohio, January 1–3, 1913.

The business proceedings are given in Part I, while the addresses, papers and discussions will be found in Part II of this report.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President W. D. Hunter, at 1.30 p. m., Wednesday, January 1, 1913. The attendance averaged about one hundred and twenty-five members and visitors. The following members were present:

George G. Atwood, Albany, N. Y.; A. W. Baker, Guelph, Canada; C. H. Baldwin, Indianapolis, Ind.; R. W. Braucher, Kent, Ohio; W. E. Britton, New Haven, Conn.; C. T. Brues, Boston, Mass.; A. F. Burgess, Melrose Highlands, Mass.; A. C. Burrill, Madison, Wisc.; Lawson Caesar, Guelph, Canada; S. C. Clapp, Raleigh, N. C.; Mel T. Cook, New Brunswick, N. J.; R. A. Cooley, Bozeman, Mont.; E. C. Cotton, Knoxville, Tenn.; G. C. Crampton, Amherst, Mass.; J. J. Davis, LaFayette, Ind.; G. A. Dean, Manhattan, Kansas; E. B. Engle, Harrisburg, Pa.; Wm. E. Evans, Jr., Painesville, Ohio; E. P. Felt, Albany, N. Y.; S. A. Forbes, Urbana, Ill.; B. B. Fulton, Geneva, N. Y.; P. A. Glenn, Urbana, Ill.; W. H. Goodwin, Wooster, Ohio; H. A. Gossard, Wooster, Ohio; C. H. Hadley, Jr., Durham, N. H.; T. J. Headlee, New Brunswick, N. J.; R. W. Hegner, Ann Arbor, Mich.; Glenn W. Herrick, Ithaca, N. Y.; C. F. Hodge, Worcester, Mass.; W. O. Hollister, Detroit, Mich.; T. E. Holloway, New Orleans, La.; J. S. Houser, Wooster, Ohio; L. O. Howard, Washington, D. C.; H. B. Hungerford, Lawrence, Kansas; S. J. Hunter, Lawrence, Kansas; W. D. Hunter, Dallas, Texas; A. D. MacGillivray, Urbana, Ill.; C. L. Marlatt, Washington, D. C.; P. W. Mason, LaFayette, Ind.; E. W. Mendenhall, Columbus, Ohio; C. L. Metcalf, Raleigh, N. C.; Z. P. Metcalf, Raleigh, N. C.; A. W. Morrill Phoenix, Ariz.; Wilmon Newell, College Station, Texas; W. C. O'Kane, Durham,

N. H.; Herbert Osborn, Columbus, Ohio; Herbert T. Osborn, Columbus, Ohio; J. H. Paine, Washington, D. C.; P. J.Parrott, Geneva, N. Y.; L. M. Peairs, Morgantown, W. Va.; E. F. Phillips, Washington, D. C.; H. J. Quayle, Berkeley, Cal.; W. A. Riley, Ithaca, N. Y.; A. H. Rosenfeld, Tucuman, Argentina; J. G. Sanders; Madison, Wisc.; W. J. Schoene, Geneva, N. Y.; H. C. Severin, Brookings, S. D.; G. D. Shafer, East Lansing, Mich.; N. E. Shaw, Columbus, Ohio; V. E. Shelford, Chicago, Ill.; H. E. Summers, Ames. Iowa; T. B. Symons, College Park, Md.; James Troop, LaFayette, Ind.; Y. H. Tsou, Urbana, Ill.; F. L. Washburn, St. Anthony Park, Minn.; R. L. Webster, Ames, Iowa; W. B. Wood, Washington, D. C.; W. W. Yothers, Orlando, Fla.; J. F. Zimmer, Washington, D. C.

A large number of visitors attended the meetings but it was not possible to secure an accurate list.

President W. D. Hunter: I have the honor of calling to order the twenty-fifth annual meeting of the American Association of Economic Entomologists. We will first listen to the report of the Secretary.

REPORT OF THE SECRETARY

At the last annual meeting of the Association a large number of associate members were elected and several transfers in the different classes of membership were made. Since that time one active, two associate and one foreign members have died and two active and two associate members have been dropped from the rolls on account of non-payment of dues.

The total membership to date is 133 active, 163 associate and 53 foreign members. This represents a net gain of twenty-six members.

During the year four of our members have been called by death. On March 21, 1913, Dr. John B. Smith, one of the founders of this Association passed away at his home at New Brunswick, N. J. He was one of the men who has made the science of entomology respected and appreciated by the public and the agricultural classes. His tireless energy and willingness to assist the struggling amateur entomologist will cause his loss to be keenly felt by all entomologists.

Edward L. Jenne, an expert of the United States Bureau of Entomology, died on May 10, 1912. He had conducted important investigations on insects affecting deciduous fruits, a part of the results having been published by that Bureau.

Clarence E. Hood died at Urbana, Ill., June 18, 1913, from injuries received in a motor cycle accident. He was carrying on investigations and introducing beneficial insects into Porto Rico previous to his untimely death.

G. H. Grosvenor of Oxford, England, was drowned off the Cornish coast during mid-summer while endeavoring to save the life of another. He was a man of much promise and had been active in his chosen work at Oxford University.

Suggestions Concerning the Journal

The subscription list of the Journal ought to be materially increased during the coming year. We need to have this publication in the hands of many who do not now subscribe. Every member should interest himself in helping the work along.

Every year there are a number of papers which are presented at the meeting but are withdrawn for publication elsewhere. It would appear that these papers should be published in our official organ if the Journal desires them. Articles published often make sales for the publication as well as extend the interest in the work and purposes of this Association.

At the time the JOURNAL was established it was desired to publish the report of the annual meeting and the papers and discussions early in the year in order that they might be available for use. With the increase in the length of our programs it will soon be impossible to publish the papers at all promptly unless the early issues of the JOURNAL are very large. It would appear, however, that this must be done, or that some time in the future when our finances will warrant, it might be well to consider the publication of an annual report separate from the JOURNAL.

FINANCIAL STATEMENT

The following statement shows a good balance in favor of the Association. Practically all the bills are paid, except the cost of printing the last issue of the JOURNAL and the balance is sufficient to cover that charge.

The bills for dues and subscriptions covering the year 1913 were sent to members in October and many of these have been paid. This explains the reason for the balance being larger than in previous years.

Association Statement

Balance in Treasury, December 23, 1911		$199.88
By amount received for dues, 1912		321.00
To stenographic report 1911 meeting	$40.67	
Stamps and stamped envelopes	30.30	
Printing	37.75	
Printing, Committee on Entomological Investigations	5.20	
Buttons, 1912	10.90	
Telegraph and express	3.80	
Clerical work, Secretary's office	18.00	
Clerical work, Legislative Committee	5.00	
One-half salary of Secretary	50.00	
	$201.62	
Balance, December 23, 1912	319.26	
	$520.88	$520.88

Journal Statement

Balance in Treasury, December 18, 1911		$59.83
By amount received from subscriptions, advertising, etc		1,825.01
To Stamps and stamped envelopes	$44.21	
Printing	1,256.40	
Halftones, etc	66.77	
Telegraph and express	5.80	
Miscellaneous supplies	5.15	
Clerical work Editor's office	85.70	
Clerical work Manager's office	47.00	
Salary, Editor	100.00	
One-half salary of Manager	50.00	
	$1,661.03	
Balance in Treasury December 23, 1912	223.81	
	$1,884.84	$1,884.84

Respectfully submitted, A. F. BURGESS,
Secretary.

On motion the report was received and the financial part referred to the auditing committee.

PRESIDENT W. D. HUNTER: I will now read the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE

The Executive Committee has held no meetings, but several matters have been considered by correspondence.

A formal invitation to send a representative of the Association to the centenary anniversary of the founding of the Academy of Natural Sciences of Philadelphia was received. Dr. L. O. Howard was selected for this mission.

A delegate to the International Entomological Congress at Oxford in August, 1912, was appointed. A formal memorandum containing the invitation of the Association to the Congress to hold its next annual meeting in the United States was prepared and placed in the hands of Prof. Herbert Osborn, who represented the Association at the meeting.

In September the Secretary received an invitation from the President of the National Conservation Congress to send a delegate to the annual meeting of the organization at Indianapolis in October.

In October the Secretary received a communication from the Secretary of the Farmers National Congress with the suggestion that delegates be appointed to attend the meeting at New Orleans on November 7 and proposing some form of affiliaton.

In both of these cases, on account of the shortness of time, the subject was not referred to the Committee on Affiliation with Agricultural Organizations. The committee decided that it would be unwise to enter into any sort of coöperation. The committee considers that the Association has certain definite aims that are only indirectly connected with the functions of the Country Life Federation and the Farmers National Congress. To extend the activities of the Association in the direction of such coöperation would be a revolutionary change in policy. It would tend to detract from the entity of the Association and to congest still further the business to be conducted at the annual meetings. The committee recommends that the matter be referred to the Committee on Affiliation with Agricultural Organizations for further consideration.

The executive committee was charged with devising means of incorporation. It is to be regretted that the committee has been unable to make any satisfactory progress. One possibility which was investigated was incorporation in the District of Columbia. It was found upon consultation with an attorney and with the District authorites that the present laws would render such incorporation impossible. These laws require that at least a majority of the members of an organization incorporated in the District shall be residents thereof.

As an alternative, incorporation by act of Congress has been considered. The American Society of Florists was incorporated by this means some years ago. We find by correspondence with the men who were connected with this matter that many obstacles were encountered, and it was practically eleven years from the time the idea was first projected until the charter was obtained. During all this time the plans of the Society were agitated by Mr. William R. Smith, superintendent of the Botanic Gardens in Washington. In spite of Mr. Smith's activity and the advantages of his location in Washington, the matter moved very slowly; in some cases it was refused consideration, and in one instance was defeated in one house of Congress after it had passed the other. It was opposed on all sorts of grounds by representatives

and senators from different quarters of the country. Finally it passed both houses of Congress, but was vetoed by President Cleveland. Later Mr. Smith ascertained that President McKinley would sign the bill if it should come to him. After a repetition of the vicissitudes that the previous bill had experienced, it was finally passed and signed by the President. Mr. M. J. Stewart, who was secretary of the Society at the time of incorporation, has written, "It is our conviction that no other human being but Mr. Smith could have accomplished what he did, and, without any reason to discourage you, would say that I think you would find it very difficult to get incorporation by act of Congress."

The Executive Committee recommends that a special committee be appointed to consider further the matter of incorporation.

Under instructions from the Associations the committee referred to the A. A. A. S. a list of the active members with the suggestion that they be made fellows of that association.

W. D. Hunter,
T. J. Headlee,
R. A. Cooley,
A. F. Burgess,
Executive Committee.

By vote of the Association the report was accepted and the recommendations adopted.

President W. D. Hunter: We will now listen to the report of the Committee on Nomenclature by Prof. Herbert Osborn.

Mr. Herbert Osborn: No list of insect names has been submitted to the committee during the year and, therefore, we have no list to report to the Association. The committee feels that an improvement in the use of common names has resulted from its work. Several books and other publications that have appeared recently have used the names suggested in the lists. We have no further report to make at this time.

By vote of the Association the report was adopted.

President W. D. Hunter: We will now call for the report of the committee on affiliation with other agricultural organizations. Mr. F. M. Webster is chairman of this committee but as he does not seem to be present, I will call on Professor Forbes for the report.

Mr. S. A. Forbes: The members of this committee which included Professor Webster, Professor O'Kane, and myself have never had a meeting. I have just received a letter from Professor Webster in which he says that he will approve any report which Professor O'Kane and myself may make. This being the case I beg leave to report that inasmuch as the present arrangement, whereby this Association holds its meetings at the same time and place with the American Association for the Advancement of Science, and its related societies, is working very satisfactory and that it does not seem advisable to make a change. The committee is of the opinion that the present arrangement in regard to holding annual meetings should be continued.

By vote of the Association the report was accepted and the recommendations adopted.

Owing to the absence of Mr. Sanderson and Mr. Symons the reports of the committees, of which they were chairmen, were postponed until the next session.

A report was read by Mr. Wilmon Newell in behalf of the Association of Apiary Inspectors, as follows:—

APIARY INSPECTORS COMMUNICATION

To the Association of Economic Entomologists: The Association of Official Apiary Inspectors of the United States and Canada, through the undersigned committee, request permission to affiliate with your Association as a "section" thereof, the chairman of such "section" to be a vice-president of your Association, and the proceedings of the "section" be published as are other proceedings of the Association of Economic Entomology.

Wilmon Newell,
S. J. Hunter,
T. J. Headlee.
Committee.

In view of the absence of Mr. Symons, chairman of the Committee on Affiliation, action on this request was postponed until the next session.

Prof. W. D. Hunter: We will next listen to the report of the committee on entomological investigations, by T. J. Headlee.

REPORT OF COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

Fellow members of the Association:—

Your Committee on Entomological Investigations for the year 1912 herewith presents its report.

At the outset this committee desires to thank the entomologists who have coöperated with it for the courtesy and encouragement with which they have aided its work.

In accordance with the usual custom an information slip was transmitted to the active membership of this society and to all other working entomologists in the United States and Canada, except to those who are connected with authorities that in the past have not seen fit to furnish information. Incidentally some workers now in our active membership list, but employed in other countries, have been reached. The committee felt that the fact that their work and interest have been such as to place them in the active membership is in itself sufficient to render the inclusion of their investigations highly desirable.

At the suggestion of Prof. R. H. Pettit of Michigan and Director C. P. Gillette of Colorado, the committee included in the slip an inquiry looking toward the formation of a taxonomic directory, which it is hoped may aid those of us who need aid in identification and those who are engaged in taxonomic studies.

The response to this inquiry has been very representative, very few of the states in which entomological work is being done failing to reply. The replies clearly indicate, however, that a considerable number, perhaps a little over half, prefer to give merely a statement of names of projects under consideration. No correspondent raised any objection to the taxonomic directory and some warmly commended it.

In accordance with the custom, a preliminary report, including a list of projects and the taxonomic directory, was prepared and has been published in the December issue of the JOURNAL. A few of the replies came after the copy of the preliminary report was sent to the printer, and the data contained in them will be found at the close of this report.

Comparatively few statements were made relative to point No. 4 of the inquiry which was "if you can find time please prepare a brief statement of what you believe to be the characteristic marks of worthy entomological investigation," and such as came indicated such a diversity of opinion that no attempt will be made to review them. In fact, your committee feels that this phase of the inquiry has not received much encouragement.

At the time the Committee on Entomological Investigations was created, it was understood that it should not only further coöperation by making known to all the different lines of study each was pursuing, but that it should stand for ideals of economic entomological investigation. The first part of its duty this present committee has discharged in its preliminary report and in the supplement with which this is closed. The second phase it now proposes to treat.

"Scientific investigation" may be defined as the collection of data relative to a certain definite matter for the purpose of advancing human knowledge of that matter beyond previous limits, and usually involves the formulation and statement of results. Of course, in entomological investigation the data collected relate primarily to insect life, and in economic entomological investigation the data refer to some phase of insect life in relation to human welfare.

No single investigator can exhaust any one department of entomological study and his investigation must necessarily, if it is to serve human kind to best advantage, form one of the building units in the edifice of knowledge. His investigation must, therefore, be so planned, conducted and especially so reported that his co-laborers in

the field, both contemporaneous and succeeding, shall be able to estimate its value and arrange their investigations in accordance therewith.

Too much of the basic data are even yet omitted and the mere conclusions stated. Conclusions are worth little to the investigator, unless he knows the data on which they are founded. This habit of reporting conclusions merely is probably largely due to the necessity under which entomologists have long been laboring, of stating their results in a purely non-technical manner, both for the purpose of saving expense and for rendering the publication "popular." This tendency your committee deplores as one not merely retarding the progress of our science; but as one exhibiting poor business judgment. Ultimately from the standpoint of the public, which we serve, any investigation sufficiently important to induce us to spend our time and the public money upon it must be of enough importance to merit a report sufficiently full that our co-laborers can plainly see from perusing it the reasons for the "faith that is in us" or public funds will have been improperly expended.

Your committee believes that every station where entomological investigations are pursued and the results published, should have at least two series of publications, in one of which data derived from investigations can be so fully stated that workers in other places can draw their own conclusions therefrom, and in the other of which the practical economic outcome of the investigations can be stated in non-technical language for the benefit of the general public.

The qualities of an investigation which render it usable by co-workers are: (1) clear and definite presentation of its relation to preceding work; (2) clear and illuminating arrangement of the new data; (3) a conservative interpretation of the meaning of these data. The first of these points involves a brief but lucid statement of progress along the particular line to the point where the investigator begins his work, and the writer should take especial care to make the references very definite. The second and third points need no amplification as they are already sufficiently explicit.

Your committee feels that the importance of meteorological conditions is such that wherever life history studies are made meteorological records should be kept and that they should be included in the final report.

Your committee believes that the percentage of investigations devoted to the discovery of general laws of reaction is too small, and that the science of economic entomology is now held back by this condition. It desires to urge upon those whose conditions permit, and inclinations adapt, the high importance of emphasizing this phase of entomological investigation.

Your committee desires to commend the practice now gaining in favor of basing recommendations for control of definite insect species on extensive tests under normal field conditions, and to deplore the continuance of the early practice of basing measures of control on merely a study of life economy.

Additions to the List Submitted in Preliminary Report

Note. In a recent letter, Dr. C. Gordon Hewitt, the Dominion Entomologist, requests a correction in the manner of reporting dominion government projects, fearing the method used in the preliminary report might lead the ordinary reader to think he personally is carrying out all of the projects. As a matter of fact Doctor Hewitt says that those projects are being carried on by various members of the Division of Entomology of Canadian Department of Agriculture.

Investigations dealing with Acarina

Montana, Bozeman,—R. A. Cooley.

179. Tick investigations in Montana with particular reference to *Dermacentor venustus.*

Investigations dealing with Orthoptera

Minnesota, St. Anthony Park,—F. L. Washburn.

180. Grasshopper control.

181. Factors in the control of Acrididæ of economic importance. C. W. Howard in immediate charge.

182. Life histories of Orthoptera. C. W. Howard in immediate charge.

Investigations dealing with Hemiptera

Montana, Bozeman,—R. A. Cooley.

183. Life history and control of the sugar beet louse (*Pemphigus betæ*).

184. Study of the control of the oyster shell scale by use of insecticides.

Peru, S. A., Lima,—Charles H. T. Townsend.

185. White scale of cotton (*Hemichionaspis minor*) and its parasites.

About 9 species of microhymenopterous parasites are at work in force on *H. minor* in Piura department, 2 species of coccinellids, 1 or more species of mites, and 1 fungus, and the host shows marked signs of decrease at present in consequence. In Peru the scale is still confined to Piura department.

186. Coccids and microhymenopterous parasites of the same in Peru.

Several hundreds of lots of coccids have been collected and thousands of parasites reared, some two or three hundred slides of latter having been prepared and studied. Many hundreds of microhymenoptera have been collected, and many mounted and studied.

Washington, Pullman,—A. L. Melander.

187. Resistance of the San José scale to insecticides.

While it may be premature to announce that the San José is developing resistant strains in certain localities, yet it is not improbable to assume this. It is certain that the effect of standard sprays varies greatly from place to place, and that the scales of certain districts seem to be acquiring a progressive immunity. I have been working on this for quite a few years now but have withheld a public announcement up to the present. Formerly the sulphur lime was almost a panacea, certainly de-

stroying eggs of red spider, aphis, and the scale. It now seems to have no effect on the first and sometimes but little effect on the others.

Investigations dealing with Lepidoptera

Minnesota, St. Anthony Park,—F. L. Washburn.

188. Spraying experiments for codling moth and curculio. A. G. Ruggles in immediate charge.

Montana, Bozeman,—R. A. Cooley.

189. Life histories and means of controlling the cut worms of Montana.

Investigations dealing with Diptera

Minnesota, St. Anthony Park,—F. L. Washburn.

190. Problems in connection with the larvæ of Muscid flies. C. W. Howard in immediate charge.

Peru, S. A., Lima,—Charles H. T. Townsend.

191. Muscoid fly reproduction investigations.

Hundreds of dissections made of female muscoid-fly reproductive systems, and descriptions and drawings prepared. Papers forthcoming.

Investigations dealing with Coleoptera

Australia, Brisbane, Queensland,—A. A. Girault.

192. Investigations of the sugar cane grubs (scarabeids in general) of Australia. Succeeded in rearing the larvæ to maturity.

Minnesota, St. Anthony Park,—F. L. Washburn and O. G. Babcock.

193. Corn bill bug.

Montana, Bozeman,—R. A. Cooley.

194. Life history and control of the sugar beet silphid (*Silpha bituberosa*).

Peru, S. A., Lima,—Charles H. T. Townsend.

195. Cotton square-weevil (*Anthonomus vestitus*) and its parasites.

About 12 species of hymenopterous parasites are at work, one in very large numbers compared with the others in the coast region of Peru, but they kill only about 18 per cent. of the host. Ants of the genus Solenopsis, very close to *S. geminata*, are present but do not seem to prey upon the weevil. *The weevil requires marked atmospheric humidity* to insure activity. It is known to exist in the cotton districts from Guayaquil south to Tambo de Mora near Pisco, in the lower coast region, but has not yet been found in the foothill cotton districts nor in the montaña.

Investigations dealing with Hymenoptera

Massachusetts, East Wareham,—H. J. Franklin.

196. Bumble bees.

Monograph on bumblebees of the New World soon to appear.

Minnesota, St. Anthony Park,—F. L. Washburn.

197. Clover-seed chalcid, *Brucophagus funebris*. Warren Williamson in immediate charge.

198. Larch saw fly. A. G. Ruggles in immediate charge.

Investigations dealing with groups of insects or with insecticides or with both

Massachusetts, East Wareham,—H. J. Franklin.

199. Cranberry insects (injurious and beneficial).

Progress fully reported in last two annual reports of the Cape Cod Cranberry Growers' Association, and in the last annual report of Massachusetts Agricultural Experiment Station.

Minnesota, St. Anthony Park,—F. L. Washburn.

200. Shade tree pests. A. G. Ruggles in immediate charge.

Pennsylvania, Harrisburg,—H. A. Surface.

201. Susceptibility of varieties of cultivated plants, especially fruits, to insect and plant-disease injury.

202. Improvement of the lime-sulphur solution.

203. Prevention of peach tree borer and certain other orchard pests.

Peru, S. A., Lima,—Charles H. T. Townsend.

204. Cotton insects in general.

Some 38 or 39 different species of insects have been found to attack the cotton plant in Peru, counting several weevils and Heteroptera which have not actually been observed to feed upon the plant but whose presence in the squares makes this habit almost certain; and of these *Hemichionaspis minor* and *Anthonomus vestitus* are especially serious, the latter probably exceeding the former in injury, while *Dysdercus ruficollis* and some 6 or 7 others cause great injury. Seven of these cotton pests are coccids:—*H. minor*, *Saissetia oleæ* (or *nigra*), *Pulvinaria* n. sp., *Coccus hesperidum* (probably), *Orthezia* sp. perhaps *insignis* (Guayaquil), *Dactylopini* sp., Coccid perhaps *Dactylopini*. More than 40 species of enemies, chiefly parasites, aside from those of *H. minor* and *A. vestitus*, have been found to attack these cotton plagues. It may be added that there are at least three serious fungus plagues of cotton in the Peruvian coast region. These observations refer to the coast region only.

205. Transmission of verruga by bloodsuckers.

Careful consideration of all available published and unpublished data seems to indicate almost certainly that verruga is transmitted to man by a tick.

206. Ticks, lice, bloodsucking Diptera and Hemiptera.

Native and domestic mammals examined for ectoparasites and many species found including ticks; many bloodsucking Diptera found, especially Simulium and tabanids in the montaña. Some interesting undetermined forms of ectoparasites found on Oryzomys and bats.

207. Citrus and other fruit pests.

Five serious citrus coccids occur in the coast region. Fruit-fly determined as *Anastrepha* sp. (not *ludens*).

208. Pests of cane, coffee, tobacco and general crops.

Seven serious cane pests occur, including montaña forms. Many pests of crops in general collected and observations noted.

Porto Rico, Rio Piedras,—D. L. Van Dine.

209. General entomological survey of the sugar cane areas of Porto Rico.

We have now a list of some twenty (20) injurious species together with many associated species. The most of this material has been identified by the specialists of the United States Bureau of Entomology at Washington. The character of the injury of these species is understood and so is the comparative amount of damage. A great deal of information has been obtained on the local distribution of the species and the factors that regulate such distribution.

210. General breeding work.

The breeding work has been in progress for only a year but some work has been done on practically all of the species affecting cane and quite a little work on a few of the more important species. At the present time the breeding work relates to the species of Lachnosterna affecting cane in Porto Rico and their local and introduced parasites.

211. Laboratory and office work.

An important start has been made towards building up a general collection of named material.

212. Field work.

A card index record is kept of all plantation inspections with cross references to the field notes on the species observed and to the individual reports sent to the plantations. The results of the coöperative experiments are filed under the species to which they relate.

213. Experimental work.

In the experimental work on the May-beetles an effort has been made to introduce natural enemies from abroad. An agent is working at the present tine in Illinois on the parasites of Lachnosterna in that locality. Various fungi have been introduced from Hawaii, the United States and France. The direct measures, in coöperation with plantations, have included the use of insecticides, repellents and picking the white-grubs behind the plows and the adults from their food plants at night.

As regards the sugar-cane moth stalk-borer, *Diatræa saccharalis*, the egg parasites of the same in Louisiana, Mexico and British Guiana are sought. An agent visited Mexico last season but was forced to return to the United States on account of the political disturbances. The direct measures against this borer include experiments on seed selection, seed treatment, covering of seed, plucking out of "dead" hearts, and the destruction of the trash after harvest.

The experimental work on the mole-cricket, *Scapteriscus didactylus*, includes different systems of planting the cane, cutting to prevent injury and trap light experiments in capturing adults at night.

The work under this heading against the sugar-cane mealy-bug, *Pseudococcus sacchari*, relates to the treatment of seed before planting and seed selection. The lady-bird beetle, *Cryptolæmus montrouzieri*, a mealy-bug feeder, has been introduced successfully from California, through the Audubon Park, New Orleans, laboratory of the United States Bureau of Entomology and has been bred and liberated throughout the cane areas in large numbers.

Washington, Pullman,—A. L. Melander.

214. Endoparasitism.

Substantial progress. Not yet ready to report.

215. Bud weevils.

Quite lately a series of over a dozen species of weevils has been troubling the fruit growers of the Columbia River basin, and elsewhere, by destroying the buds of young trees early in the spring. The damage often has been serious. A concern near Brewster has been manufacturing tree collars of enameled tin to protect against the weevils ascending.

Taxonomic Directory

Muscoid flies

Charles H. T. Townsend, Lima, Peru, S. A., will classify as time permits. Will send names in return for specimens. Correspondents please await further notification regarding permanent address.

Empididæ

A. L. Melander, Pullman, Washington, will classify. Will classify other dipterous groups by special arrangement.

Chalcidoidea

A. A. Girault, Brisbane, Queensland, Australia, will classify.

Bombidæ

H. J. Franklin, East Wareham, Mass., will classify to limit of his spare time.

T. J. Headlee,
Glenn W. Herrick,
W. C. O'Kane,
Committee.

President W. D. Hunter: Is there any discussion on this report?

Mr. H. A. Gossard: I would like to inquire of Mr. Headlee as to how many of our working entomologists have declined to make report to this committee. There are a great many workers who are very favorable to this project, particularly if it is supported by all, but there are some who do not care to put themselves at the mercy of investigators who will not report.

Mr. T. J. Headlee: There are ten states in which entomological investigations are going forward from which no reports have been received. No letters containing refusals have been received. One investigator said he was not in sympathy with the work but submitted a list of projects. With a few exceptions the men who have hitherto supported the work are continuing to do so, and some who have not hitherto reported have this year submitted lists of projects. There seems to be a general feeling among investigators that the only information given with regard to the projects under consideration should be a list of the different lines of investigation.

Mr. P. J. Parrott: I am glad to learn that so many are in sympathy with the work and if it is desired I shall continue to submit a list of our projects. I must confess that I have often wondered whether the method which is being used is accomplishing anything. I have no objection whatever to the work which is being carried on by this committee, but I seriously question if it is worth while.

President W. D. Hunter: It seems to me that there is an important part of this work which has not been mentioned and which should be of great value to all working entomologists. As the result of the publication of the list of the projects which are being taken up by the various men in different parts of the country each individual has an opportunity to ascertain what others are doing and this will in many cases prevent unnecessary duplication of work. An examination of the projects listed also gives one an opportunity to determine instantly the men who are working on any particular class of investigations so that it is very easy to get in touch with them.

Mr, W. E. Britton: I have always been in favor of the work of this committee, though I have understood that some workers object to giving out the names of projects. I can see but one reason for this. Some of us are burdened with teaching, inspection, correspondence or other routine work. The funds and time for original research are limited. Each would like to carry on a certain amount of research work and we make our plans to do so, even though in doubt as to whether we shall be able to carry the work through to a finish. If the project is not published and the plans fall by the way, no one is the wiser: if published, then we are obliged to confess our inability

to continue the work. In fact the term project has rather too ambitious a sound for the scattered and fragmentary investigations which are all that some of us are able to accomplish.

President W. D. Hunter: Are there any further remarks? If not, we will now vote on the adoption of the report of the committee.

By vote of the Association the report was adopted.

President W. D. Hunter: We will now listen to the report of the employment bureau for entomologists, by Mr. F. L. Washburn.

Mr. F. L. Washburn: I wish to make a brief report on the work which has been attempted. You all understand that this has been carried on for only one year and is in the nature of an experiment. It has been decided during the coming year that a little more publicity will be given to the work by placing a brief notice concerning it in the Journal of Economic Entomology, so that entomologists who wish to secure men may know where to apply and that entomologists desiring employment can have an opportunity of registering with the Bureau, if they see fit. I took charge of this work last year in order to see if a plan of this sort might not be made of value to the Association, and I have consented to continue with the work another year, so that it may be given further trial. The same degree of confidence with the men will be respected as in the past. It should be said, however, that although the Bureau will continue to carry on the matters entrusted to its charge in a strictly confidential manner, that it cannot in any way require the institution or parties, who may desire to obtain men, to do the same. It is proposed during the coming year to reduce the fee for registration from $4.00 to $2.00, as it is believed that the latter amount will be ample to cover the cost of clerical work, postage, etc.

President W. D. Hunter: What action do you wish to take on the report of the employment bureau?

On a motion by Mr. Gossard the report was adopted.

President W. D. Hunter: We will next listen to the report by Professor Osborn who was selected to represent this Association at the International Congress of Entomology at Oxford, England.

REPORT OF DELEGATE TO INTERNATIONAL CONGRESS

To the Association of Economic Entomologists:

Your President was so good as to honor me with the duty of serving as a representative of this Association, at the meeting of the Second International Congress, and it is my pleasure to report upon some of the activities of the Congress.

It may be stated at first that from the organization of the Congress, which is made clear in the first volume of proceedings, which appeared only a short time before the opening of the Second Congress, and which had not been distributed at the time of my appointment, it is found that the Congress does not make any provision for the

formal recognition of delegates or representatives from different Entomological Societies. Your representative therefore, can not report any action of the Congress which was taken as a result of consideration or action of the body of delegates but can simply indicate what occurred in the way of general sessions, and of such parts of the business as was transacted by the Congress sitting as a whole, and which consisted mostly of adoption of reports of the Executive Committee. In this connection, it might be in place to state that the organization of the Congress appears to the representative, to be entirely inadequate to the consideration and efficient action upon questions of international concern in entomology, and that while our Society as individual members associating themselves with the Congress and doing everything possible to further its cause and secure an adequate organization, that at present any action that we may take as a Society can serve only as a stimulus for such organization. While there were representatives present from Entomological Societies of Germany, Switzerland, Sweden and other countries, as well as the United States, not any of these was given recognition as such representative and in all votes of the Congress, the votes of such a representative had no more weight than that of some individual, possibly resident of the locality, with no entomological training, but who might have paid the membership fee and secured the rights of membership. Such an organization while eminently democratic can certainly not be looked upon as a basis for coöperation amongst the entomologists or particularly the Entomological Societies of the world, as it must invariably happen each year, that there will be a large local representation far outnumbering individual representatives of Societies from distant countries.

In the matter of nomenclature, a move was undertaken and carried through to secure an international committee, which might present for the approval of the Congress, such regulations as might be agreed upon by the entomologists of various countries. While this is perhaps in the best form possible, it is easy to be seen that there are other questions of international concern, for instance, general postal rules etc., that such a Congress should consider, and with some adequate organization for international representation, such questions can be acted upon in a way that will command the support of the Societies of Entomologists in general. Possibly a resolution of the Society asking the Executive Committee of the Congress, to devise some method of international or Society representation, which would secure something like uniform recognition to the different countries, to be provided at as early a date as possible might have a good effect.

One particular feature of the Congress that may be highly commended is the opportunity given for making acquaintance with the entomologists of the various countries, and there can be little question but this opportunity will be productive and in time be of much worth to the Science of Entomology.

In the matter of social opportunities, the Congress offered many opportunities which were highly appreciated. The receptions, excursions and other social features permitted an excellent opportunity for making acquaintance and such acquaintance was enjoyed much by all present.

The opportunity to see the rich collections in entomology, accumulated at Oxford was also a privilege of no small account. The Congress after its adjournment at Oxford went, almost as a body, to Tring on invitations of Mr. Rothschild and enjoyed an exceptional day in examining his wonderful collection of Lepidoptera and the abundant hospitality which he showed on the occasion.

A considerable number of the members also assembled later in London and gathered incidentally at the Natural History Museum, where the insect collections were the center of attraction.

The invitation of the Society for the next Congress to meet in America for its next

session, was duly presented and your representative urged upon the committee in charge, to the best of his ability, that this country be selected for the next Congress. This was ably supported by a number of other American entomologists, especially certain of the delegates from the Entomological Society of America, but the committee had quite determined upon a European meeting for the next Congress, and our efforts were futile.

We were given, however, cordial assurance of the desire of the Congress to meet in America in the near future, with the quite positive assurance that the next succeeding Congress should come here, if our invitation for the second period be given. Your representative felt free to assure the committee that in all probability our invitation would be as cordial as for the present occasion.

While regretting that this particular mission could not be fulfilled and that there is no more actual growth to report, I desire to urge the Society to extend its cordial support of the Congress, and that as many of the members as possible should become members and if possible attend the next session to be held at Vienna, under the presidency of Doctor Handlirsch, and that we exert our influence toward such a development of the Congress as will serve to make it a world-wide influence in the development of our Science.

Respectfully submitted,

Herbert Osborn,

Delegate.

President W. D. Hunter: I do not think a special motion is necessary relative to this report. I will, however, in behalf of the Association extend our thanks to Professor Osborn.

Mr. H. A. Gossard: I believe that the position of this Association would be better understood by the International Congress of Entomology, and would be little more emphatic if we should ask that the changes suggested by Professor Osborn be made. I move, Mr. President, that Doctor Forbes and two other members, to be named by the Chair, be appointed to consider this matter and report a resolution for action by the Association before the close of this session.

By vote of the Association this motion prevailed and the following committee was appointed.

Messrs. Forbes, Britton, and Osborn.

Under the head of miscellaneous business the secretary presented an invitation from the directors of the Panama-Pacific Universal Exposition for this Association to hold its annual meeting in 1915 at the exposition in San Francisco. He stated that he had advised the Executive Officer of the exposition that it was the custom of this Association to hold its annual meeting in connection with the meeting of the American Association for the Advancement of Science, but that the matter would be brought to the attention of this Association. The Secretary also presented two designs for permanent buttons for use of the members of the Association, should they care to adopt a button for general use. Some few years ago this matter had been considered by the Association but no definite action had been taken.

By vote of the Association both of the above-mentioned matters were referred to the Executive Committee.

Mr. H. A. Gossard, in behalf of the A. I. Root Company of Medina, Ohio, and of the Ohio Agricultural Experiment Station, presented an invitation for the members to visit the extensive apiaries and plant of the A. I. Root Company and the Entomological laboratories of the Experiment Station at Wooster, Ohio, before the close of the meetings. He stated that arrangements would be made so that this trip could be taken by all members who were interested and had the time at their disposal to do so. The President expressed the thanks of the Association to Mr. Gossard and advised all members who desired to make the trip to arrange with Mr. Gossard.

Mr. R. L. Webster: I have a matter which I would like to bring before the Association at this time relative to the Bibliography of Economic Entomology. I was much surprised to learn recently that the publication of this bibliography had been discontinued and that entomologists were now referred to the Experiment Station Record in its place. The references contained in that publication, however, are not so full as most entomologists desire and I think that most of us have found the Experiment Station Record to be an unsatisfactory substitute. The Bibliography of Economic Entomology, as compiled by Henshaw and Banks, has been brought down to 1905, so that it is now about seven years since the last number appeared. Now if the Department of Agriculture at Washington cannot publish this bibliography along the same line as it was published before, it seems to me that this Association should take the matter up. I would like to hear this matter discussed and see if some plan cannot be suggested for the continuation of this valuable bibliography in the future.

Mr. E. P. Felt: I very frequently refer to the bibliography of economic entomology, and have always found it extremely useful. There is considerable difficulty in securing all the references to literature on entomology, and as the number of publications are increasing rapidly this will be much more difficult in the future. Something of this nature ought to be published and if it cannot be secured in any other way I think it might be attempted by the Association. Of course, this will mean considerable expense but some way should be found to handle the matter. I would move that this project be referred to a special committee.

Mr. W. C. O'Kane: I would like to ask if the Bureau of Entomology does not keep a card index covering the bibliography of economic entomology.

President W. D. Hunter: As I understand the matter a card catalogue is now kept by the Bureau. It seems to me that it would

be desirable for the Bureau to publish this information in order to bring the references up to date. I believe, however, that the discontinuance of the publication of the bibliography was decided upon some years ago. It may be possible, however, to have this matter taken up and a change in policy adopted.

By vote of the Association the matter was referred to a special committee of three to be appointed by the Chair.

The President announced the appointment of the following committees:

Committee on auditing: Mr. W. W. Yothers, Mr. R. L. Webster.

Committee on resolutions: Mr. R. A. Cooley, Mr. F. L. Washburn, Mr. H. J. Quayle.

Committee on nominations: Mr. E. P. Felt, Mr. S. J. Hunter, Mr. W. C. O'Kane.

Committee on Incorporation: Mr. E. P. Felt, Mr. W. C. O'Kane, Mr. A. F. Burgess.

Committee on Bibliography of Economic Entomology: Mr. S. A. Forbes, Mr. Glenn W. Herrick, Mr. R. L. Webster.

Committee on Amendments to the Constitution: Mr. W. E. Britton, Mr. Wilmon Newell, Mr. A. W. Morrill.

At the morning session, Thursday, January 2, the President called for the report of the Committee for Testing Proprietary Insecticides. The Secretary read a letter which he had received from Mr. Sanderson, chairman of this committee, stating that no work had been done by the committee during the year and suggesting that it be discontinued.

By vote of the Association the report was accepted and the committee discharged.

President W. D. Hunter: I will now call for the report of the committee on legislation, which has been received from Mr. Sanderson.

REPORT OF THE COMMITTEE ON LEGISLATION

Gentlemen:

Your committee on legislation begs leave to report that it was represented at a hearing on the Simmons bill before the committee on agriculture of the House of Representatives, on February 19, 1912, at which the measure was fully discussed with interested representatives from various parts of the country and by the legislative committee of the American Nurserymen's Association. The committee kept in close touch with this measure after that, and, through correspondence and otherwise, aided in the final passage of the measure on the last day of the session in August last. This act, although not all it might be desired, is a long step in advance, and has already been used to good advantage by the federal board in charge of its enforcement.

Respectfully submitted,

For the COMMITTEE,

E. D. Sanderson,

Chairman.

By vote of the Association the report was accepted and the committee discharged.

President W. D. Hunter: The next order of business is the report of the special committee on amending the Constitution.

Mr. W. E. Britton: In connection with this report I will say that it is the understanding of the committee that it would be desirable, in case the proposed affiliation is brought about between this Association and the Association of Horticultural Inspectors and the Association of Apiary Inspectors, that one vice-president of this Association be a horticultural inspector and that the other vice-president be an apiary inspector. It seems probable that it will also be necessary to divide future meetings into sections and it will be the duty of the vice-presidents to preside as chairmen over the sections which they represent.

REPORT OF COMMITTEE ON AMENDMENTS TO THE CONSTITUTION

The following changes in the constitution have been proposed:

Strike out the first sentence in Article II, Section 1. In the following sentence after the word "entomologists" add "horticultural or apiary inspectors," so that the sentence will read as follows: "All economic entomologists, horticultural or apiary inspectors employed by the federal or state governments may become members." Making the Section read as follows:

Section 1. All economic entomologists, horticultural or apiary inspectors employed by the General or State Governments or by the State Experiment Stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology may become members.

In Article III, Section 1, omit the last sentence, which provides for the appointment of the membership committee by the President of the Association.

This committee approves these changes and recommends their adoption.

The constitution provides that all officers and committees not otherwise provided for shall be elected by ballot on the recommendation of the Committee on Nominations. We therefore recommend that a committee on membership be elected at this meeting, one to serve three years, one for two years, and one for one year, and that at each subsequent meeting one member be elected for a period of three years.

Respectfully submitted,

W. E. Britton, *Chairman*,
Wilmon Newell,
A. W. Morrill,
Committee.

President W. D. Hunter: I believe it would be well to hear the report of Professor Symons of the Committee on Affiliation with Horticultural Inspectors, before acting on this report.

Mr. T. B. Symons: I am submitting the following report which is drawn up in the form of a resolution to which is attached a plan of the proposed affiliation:

REPORT OF THE COMMITTEE ON AFFILIATION

Whereas; a committee of this Association has conferred with similar committees of the American Association of Official Horticultural Inspectors and the American Association of Apiary Inspectors for the purpose of considering a plan whereby affiliation may be brought about with this Association, and,

Whereas; it is the opinion of the members of these committees that affiliation is desirable and will bring about better results and at less expense to the members than by maintaining separate and distinct organizations.

Resolved, That the plan outlined below be submitted to each Association concerned at its forthcoming annual meeting and that the same shall be put in force immediately if approved by the Associations concerned.

Plan

In order to bring about affiliation, the American Association of Economic Entomologists agrees to amend its constitution to enable the present members of the American Association of Official Horticultural Inspectors and the American Association of Apiary Inspectors to become members and that said amendment will be made by striking out the first sentence of article II, section 1 of the constitution, which reads as follows: "The membership shall be confined to workers in economic entomology," and in the following sentence after the words "entomologists" there shall be added words "or horticultural or apiary inspectors," so that the sentence will read, "All economic entomologists, horticultural or apiary inspectors employed by the Federal or State governments . . . may become members.

The members of the American Association of Official Horticultural Inspectors and American Association of Apiary Inspectors, who are not at present members of the American Association of Economic Entomologists, will, after making regular application for membership, be admitted on the same basis as other members.

After the affiliation has been accomplished, the annual meetings of the American Association of Economic Entomologists shall be arranged so that the Horticultural Inspectors may meet as the section of Horticultural Inspection, and the Apiary Inspectors may meet as the section of Apiary Inspection and the programs shall be made up so that as few papers as possible of mutual interest shall be presented at the same time before the American Association of Economic Entomologists and its sections.

The American Association of Economic Entomologists further agrees that one vice-president of its Association shall be a recognized Horticultural Inspector and he shall have general direction over and preside at, the meetings of the section of Horticultural Inspection and a similar arrangement shall be put in force for the section of Apiary Inspection. The secretary of the American Association of Economic Entomologists will have charge of the preparation and arrangements for the meetings, the general make-up of the program and the publication of the proceedings of the Association. Each section shall select its own secretary to keep a record of the proceedings and discussions at the sectional meeting and he shall prepare them for publication. It shall be the privilege of each section to bring any matters of special interest in its work to the attention of the American Association of Economic Entomologists for action by that Association.

The proceedings of the American Association of Economic Entomologists and sections, together with such papers as may be presented, shall be given equal privileges for publication in the JOURNAL OF ECONOMIC ENTOMOLOGY.

T. B. SYMONS,
A. F. BURGESS,
T. J. HEADLEE,
Committee.

Mr. E. P. Felt: It seems to me that we ought to act first on the report of the committee on amending the Constitution and I move that the report of this committee be adopted.

By vote of the Association the report was adopted.

President W. D. Hunter: We will now consider the report of the Committee on Affiliation as made by Mr. Symons. What is your pleasure?

Mr. T. B. Symons: In order to bring this matter before the Association for consideration and discussion, I move that the report be accepted.

Mr. W. C. O'Kane: I should like to ask if it is the understanding that the members of the Association of Horticultural Inspectors and Apiary Inspectors be admitted as members of this Association.

Mr. T. B. Symons: Membership in this Association will, according to the report, be subject to the same requirements as heretofore. The members of the Association of Horticultural Inspectors and Apiary Inspectors who do not at the present time belong to this Association will be admitted if recommended by our membership committee.

Mr. W. C. O'Kane: Have you both active and associate members in the Association of Horticultural Inspectors?

Mr. T. B. Symons: Yes; but at the present time there are only a small number of Horticultural Inspectors who are not already members of this Association.

Mr. W. C. O'Kane: Can you tell me how many members of the Apiary Inspectors Association are members of this Association?

Mr. Wilmon Newell: Possibly fifteen or twenty members of this Association are now active members of the Association of Apiary Inspectors.

President W. D. Hunter: Is there any further discussion? If not, I will now put the motion to accept the report of this committee. The motion was duly carried.

At the afternoon session, January 2, the following report was submitted by the Committee on International Congress of Entomologists, by Dr. S. A. Forbes.

REPORT OF SPECIAL COMMITTEE ON INTERNATIONAL CONGRESS

The committee presents the following resolution:

Resolved, That we desire to express to the management of the Second International Congress of Entomologists our lively interest in the continued success of the Congress movement, our cheerful acquiescence in the decision of the Congress to hold its next session on the continent of Europe rather than in America, and our earnest wish that it may so perfect its organization as to give to its actions and conclusions the authority of a thoroughly representative body. To this end we hope that

it may, at the earliest opportunity, adopt a constitution prepared by a committee of its own appointment, providing for the delegate representation and adequate voting power of the various entomological societies and institutions of the world, and for the election of its own officers and executive agents on nominations to be made by a regularly constituted committee, or by its members in open meeting. Until these or similar steps are taken, we are of the opinion that the recommendations and pronouncements of the Congress are likely to be taken as of no general or permanent validity, but as expressions of opinion, merely, by a majority of the individuals who chance to be present at its meetings.

Stephen A. Forbes,
Herbert Osborn,
Wilton E. Britton,
Committee.

The report was adopted.

At the final session Friday morning, January 3, the following business was transacted:

President W. D. Hunter: We will now listen to the report of the Auditing Committee by Mr. W. W. Yothers.

REPORT OF THE AUDITING COMMITTEE

We, the undersigned, do hereby certify that we have examined the books, accounts and vouchers of the Secretary of this Association and have found the same to be properly kept and correct.

Respectfully submitted,
W. W. Yothers,
R. L. Webster,
Committee.

By vote of the Association the report of this committee was accepted.

President W. D. Hunter: We will now listen to the report of the Committee on Resolutions, by Mr. R. A. Cooley.

REPORT OF COMMITTEE ON RESOLUTIONS

Mr. President and Members of the American Association of Economic Entomologists:—

Your Committee on Resolutions respectfully submits the following:

Whereas,—The Cleveland Normal Training School has provided this Association with commodious and pleasant quarters and has so generously furnished many other facilities for this meeting, be it

Resolved,—That we extend to the authorities of the Normal School and particularly to Professor Whitman our sincere thanks.

Whereas,—The Association has received many courtesies and evidences of hospitality from Professor Gossard and his associates, be it

Resolved,—That we extend to these gentlemen our appreciation and thanks.

Whereas,—An annually published review of insect outbreaks in the United States is of value as a record and for the information of entomologists, and

Whereas,—The Association regrets the discontinuance of such a review as formerly published in the Yearbook of the Department of Agriculture, be it

Resolved,—That we petition the Chief of the Bureau of Entomology to, in the future, prepare such reviews for publication each year in the JOURNAL OF ECONOMIC ENTOMOLOGY.

Whereas,—It is evident that this Association has attained an enviable reputation and is destined to exercise a still greater influence upon the development of economic entomology throughout the world, therefore be it

Resolved,—That the efforts of the membership committee to maintain a high standard for active membership and to exercise a most careful scrutiny of the qualifications of associate members be heartily endorsed.

Whereas,—Our program is year by year becoming increasingly crowded, be it

Resolved,—That we reaffirm an earlier resolution limiting all papers to fifteen minutes excepting under extraordinary conditions and be it

Resolved,—That in the future members be limited to one paper and be it further

Resolved,—That no papers by non-members be admitted to the program.

R. A. COOLEY,
F. L. WASHBURN,
H. J. QUAYLE,
Committee.

By vote of the Association the report of the Committee on Resolutions was accepted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Incorporation, by Mr. E. P. Felt.

REPORT OF SPECIAL COMMITTEE ON INCORPORATION

Your committee after a preliminary consideration of the various problems involved, requests that it be continued and authorized to proceed with the incorporation of the Association, provided it is found practicable and can be accomplished at an expense not to exceed fifty (50.00) dollars.

Respectfully submitted,

E. P. FELT,
W. C. O'KANE,
A. F. BURGESS,
Committee.

By vote of the Association the recommendations of the committee were adopted.

PRESIDENT W. D. HUNTER: We will now listen to the report of the Committee on Membership, by Mr. H. E. Summers.

REPORT OF THE COMMITTEE ON MEMBERSHIP

The Committee on Membership submits the following report and recommendations:

For foreign membership:

Andrew Rutherford, Maryburgh Cottage, Blair Adam, Scotland.

For transfer from associate to active membership:

Burton N. Gates, Amherst, Mass.
E. A. McGregor, Dallas, Texas.

For associate membership:

George G. Atwood, Albany, N. Y.
A. W. Baker, Guelph, Canada.
C. H. Baldwin, Indianapolis, Ind.
E. R. Barber, New Orleans, La.
O. C. Bartlett, Phoenix, Ariz.
G. G. Becker, Fayetteville, Ark.
C. W. Creel, LaFayette, Ind.
J. A. Dew, Auburn, Ala.
W. P. Flint, Urbana, Ill.
Henry Fox, LaFayette, Ind.
B. B. Fulton, Geneva, N. Y.
P. A. Glenn, Urbana, Ill.
C. C. Gowdey, Entebbe, Uganda, British East Africa.
C. H. Hadley, Jr., Durham, N. H.
R. W. Hegner, Ann Arbor, Mich.
C. F. Hodge, Worcester, Mass.
C. W. Howard, St. Anthony Park, Minn.
T. H. Jones, Rio Piedras, P. R.
Vernon King, Wellington, Kans.
Philip Luginbill, Columbia, S. C.
P. W. Mason, LaFayette, Ind.
J. W. McColloch, Manhattan, Kans.
C. L. Metcalf, Raleigh, N. C.
J. D. Neuls, Whittier, Cal.
H. R. Niswonger, Lexington, Ky.
J. H. Paine, Cleveland, Ohio.
T. H. Parks, Greenwood, Miss.
Alvah Peterson, Urbana, Ill.
G. E. Sanders, Ottawa, Canada.
V. E. Shelford, Chicago, Ill.
G. D. Smith, Tallulah, La.
Y. H. Tsou, Urbana, Ill.
H. B. Weiss, New Brunswick, N. J.
R. N. Wilson, Tempe, Ariz.

Delinquent Members

The Committee on Membership wishes to report that six active and eleven associate members are in arrears for dues for two or more years. The committee recommends that the Secretary be instructed to notify these members of their delinquencies and if same are not paid within sixty days that he be instructed to drop their names from the roll.

Membership

The Committee recommends that a member of this Association moving to any other country be permitted to retain his membership if he so desires. It shall not be the policy of the Association to transfer such a member to the list of foreign members.

We also recommend that the Association reaffirm its previous policy of electing to active membership from the list of associate members only.

The committee recommends that in our form for application for membership in

the sentence reading "I hereby make application for membership in the Association of Economic Entomologists," the word "Associate" be inserted before the word "Membership."

H. E. Summers, *Chairman*,
R. A. Cooley,
Wilmon Newell,
Committee.

Mr. W. C. O'Kane: I move that the recommendations of the committee be endorsed and adopted (carried).

President W. D. Hunter: Mr. R. L. Webster will now present the report of the committee on Bibliography of Economic Entomology.

REPORT OF SPECIAL COMMITTEE ON BIBLIOGRAPHY OF ECONOMIC ENTOMOLOGY

Your committee appointed to consider the question of the continuation of the bibliography of American Economic Entomology begs leave to report the following resolutions for presentation by this Association to the Secretary of Agriculture.

Whereas,—the Department of Agriculture has published an indispensable bibliography of economic entomology up to 1905 and

Whereas,—the department has discontinued the publication of this bibliography, which is of the highest value and aid to workers in economic entomology in the United States, and

Whereas,—this discontinuance has proved a most serious handicap to the progress of this science in this country, and no publication adequately supplying the same need has taken its place, be it

Resolved,—that the Honorable Secretary of Agriculture be respectfully requested by this Association to continue the publication of this most important and serviceable work.

Your committee further suggests that the President of this Association be asked to appoint a committee of three who, in the event that the Secretary of Agriculture does not see fit to continue the publication as requested, shall consider the possibility of maintaining this bibliography by other means.

S. A. Forbes,
Glenn W. Herrick,
R. L. Webster,
Committee.

The report was adopted.

President W. D. Hunter: Next on the program is the report of the Committee on Nominations, by Mr. E. P. Felt.

REPORT OF COMMITTEE ON NOMINATIONS

For president, P. J. Parrott, Geneva, N. Y.

For first vice-president, E. L. Worsham, Altanta, Ga.

For second vice-president, Wilmon Newell, College Station, Tex.

For councilors of the American Association for the Advancement of Science, H. E. Summers, Ames, Ia., E. D. Sanderson, Morgantown, W. Va.

For members of the Advisory Board of the Journal of Economic Entomology, C. P. Gillette, Fort Collins, Col. W. E. Hinds, Auburn, Ala.

For the committee on nomenclature, W. E. Britton, New Haven, Conn.

For committee on Entomology Investigations, W. C. O'Kane, Durham, N. H.

For committee on membership,

For three years, Wilmon Newell, College Station, Tex.

For two years, R. A. Cooley, Bozeman, Mont.

For one year, H. E. Summers, Ames, Ia.

E. P. Felt,
S. J. Hunter,
W. C. O'Kane,
Committee.

Mr. H. E. Summers: I move that the report be adopted.

By vote of the Association the Secretary was instructed to cast a ballot for the members recommended as officers by the committee.

The ballot was cast and the officers were declared duly elected.

Mr. Wilmon Newell: I would like to ask if the action taken by the Association on the report on affiliation, presented by Mr. Symons, is final.

President W. D. Hunter: As I understand it the action taken on that report settled the matter finally.

Mr. Wilmon Newell: Because of the fact that a number of the members are not clear as to the provisions made in the report I move that the adoption of that report be reconsidered.

After considerable discussion, the most of which was of a technical and parliamentary nature, it was voted that the report be reconsidered. Thereupon a motion was made by Mr. Newell that the second paragraph in the report, under the heading "plan," be amended to read as follows: "Members of the American Association of Official Horticultural Inspectors and American Association of Apiary Inspectors who are not at present members of the American Association of Economic Entomologists, may make regular application for membership in the latter Association.

By vote of the Association the amendment prevailed and the report was changed accordingly.

President W. D. Hunter: Is there any further business before we proceed to adjourn?

Secretary A. F. Burgess: I move that the next meeting be held in conjunction with that of the American Association for the Advancement of Science at Atlanta, Ga.

Carried.

Adjournment.

PART II

President W. D. Hunter: I will ask first vice-president Headlee to take the chair.

Vice-President Headlee: We will now have the pleasure of listening to the annual address of the President.

AMERICAN INTEREST IN MEDICAL ENTOMOLOGY

By W. D. Hunter, *Bureau of Entomology*

Introductory

There is no doubt that medical entomology is the branch of the science which is most in the public eye at this time. The discoveries that have been made in very recent years are most astonishing in their importance and equally so in the rapidity with which they have crowded upon one another. We are inclined, possibly, to look upon medical entomology as a subject which is of more vital interest to other nations than it is to the United States. A large portion of the literature is devoted to sleeping sickness, filariasis, trypanosomiasis and other diseases which have not yet affected directly the people of this country. General interest in the subject has recently been intensified by a number of noteworthy publications by Americans, but the writer is under the impression that the general importance of the subject is not fully realized by American entomologists. It is for this reason that the opportunity is taken to point out some of the respects in which American entomologists are especially concerned.

There is danger that the recent activity in England through the schools of Tropical Medicine and the Entomological Research Committee will tend to place other countries ahead of this one in their contributions to medical entomology. Foreign nations recognize that in applied entomology there is only one field in which we are surpassed, namely, the study of forest insects. In that field we are making rapid progress, and a distinguished German student, Dr. K. Escherich, has recently written that unless his country bestirs itself, it will soon be distanced by the United States. Considerations other than our obligations to our constituents therefore impel us to view the subject of medical entomology with some attention.

We do not overlook the fact that work done in America has affected profoundly the subject throughout the world. The work of Smith and Kilbourne on splenetic fever of cattle helped to lay the original foundation for the study of insect-transmitted diseases. This discovery, following Manson's work on Filaria transmission by a

mosquito, changed all the conventional conceptions regarding a large class of diseases, and has been the stimulus to all of the discoveries that have followed. Moreover, the work of the Reed commission in Cuba added the third important disease to the list of those transmitted by insects as necessary agents. The carefulness of the experimentation was a model for subsequent work. Later, in the control of yellow fever in Cuba by the destruction of the mosquito conveyor, the United States made a most important contribution to the subject. Still more recently the sanitation of the Canal Zone has been an extensive and inspiring object lesson to other nations.

While this work has been going on other phases of the subject have received attention in this country. Dr. L. O. Howard has been the foremost contributor. His work on mosquitoes and the house fly, and numerous papers on the economic losses caused by insects have been a powerful influence in bringing about a realization of the necessity of the study of insects in connection with diseases. The climax of this work is the elaborate monograph of the Culicidæ which is about to be issued by the Carnegie Institution. Other entomologists have also added to the available knowledge. Doctor Felt, Doctor Forbes, Professors Doane and Herms of California, Mr. Bishopp, Professor Cooley and Mr. Brues have advanced the subject very materially. Impressive as this list of contributors is, as we shall attempt to show, it does not represent more than a small fraction of the work that is demanded.

The Function of the Entomologist in the Investigation of Insect-borne Diseases

As this is a rather new subject and our conceptions in some respects are not fully clarified, we may find it useful to refer to the function of the entomologist in the study of diseases. In doing so we acknowledge without reservation that it is primarily the medical profession that has benefited the world by work on insect-borne diseases. Smith and Kilbourne, Ross, Manson, Reed and his colleagues, Marchaux and Salembeni, Dutton and Todd and Ricketts—all intimately associated with splendid achievements—were not entomologists.

In the first place entomologists are needed in the experimental work that will lead to either a demonstration or a denial of the existence of insect porters of any particular malady. Suppose, for instance, we have a disease the etiology of which is obscure and which theoretically may be transmitted by insects. The first step to be taken is to determine what insects should be taken into consideration. Here the knowledge of the entomologist on the life history and habits of the different species comes immediately into play. He can furnish an

intelligent list of suspects, whereas the non-entomological investigator would be compelled to grope about in the darkness and might experiment for years along fruitless lines. In this connection let us refer to the work of Reed and his colleagues on yellow fever. That was a case in which no time was lost and in which it might appear that a knowledge of entomology had little to do with the solution. In making plans to determine whether an insect was the transmitter of the disease, Doctor Reed and his colleagues went to Doctor Finlay. He was not an entomologist, properly speaking, but had been studying mosquitoes for many years. These studies made him familiar with the habits of the Cuban species. He had learned that one species alone should be considered. He had specimens in his possession and actually gave Reed the eggs from which were bred the first mosquitoes that conveyed yellow fever in the experiments. To this extent the work of the Reed commission was started without delay on the right course on account of the entomological knowledge of Doctor Finlay. Moreover Reed and his collaborators were in constant communication with Doctor Howard and spent some time in Washington studying mosquitoes while the Cuban experiments were under way.

When a list of possible transmitters of a disease is formulated and transmission experiments begin, the work of the entomologist is even more essential than before. It is necessary to obtain specimens, breed them and handle them. Immediately a host of points about feeding and manipulation come up, and here again the entomologist is the only man who can supply the information. Suppose the investigation has been continued and it has been found that one or more species are the sole or important agents in the transmission of the malady. At this juncture the work of the entomologist becomes more important than at any other time. In fact, here something close to a separation between entomology and medical science takes place. The control of the disease becomes a question of the control of the transmitting agent and no one can deny that the entomologist is more fitted than anyone else to devise means for the control of insects and to carry them out.

The present practical unanimity of opinion that the primary method of controlling insect-borne diseases is through attack against the insect host and that the control of the human host is secondary is the outcome of practical experience. After the demonstration of the carriage of yellow fever by the mosquito, the first idea of medical men was to control the human host by isolation and to suppress the insect host only as a supplementary measure. The work of Gorgas at Havana in 1901, of Liceaga in Vera Cruz, of White in New Orleans and of Gorgas in Panama was all based upon this conception. But now

the very men who accomplished this magnificent work have changed their views. We quote from Dr. H. R. Carter, "Yet Gorgas now believes, and I think all who participated in the work here concur with him unreservedly, that his success in Havana and on the Isthmus was due to the war waged against the Stegomyia directly, by the destruction of their breeding places, undertaken as an adjuvant to the isolation of the sick, rather than to that isolation itself; to the control of the insect rather than of the human host."

As Doctor Carter points out, the elimination of the disease by the management of the human host failed because that host could not be controlled. We believe that the experience with yellow fever will be duplicated in practically all insect-borne diseases. Apparently healthy carriers will always interfere with attack against the disease through the human host. Nothing short of the suppression of the insect host will yield satisfactory results, and it is most encouraging that medical men seem practically universally to have arrived at this conclusion. The recent work of Celli in Italy in which medication with quinine rather than Anopheles destruction is the basis, is an exception.

The recent work on *Stomoxys calcitrans* and poliomyelitis shows in a striking manner one of the incidental reactions of such discoveries on the entomologist. The work of Brues, Sheppard and Rosenau elevates the stable fly immediately from a position of one which has but little interest, except in connection with live stock, to one of extreme importance in connection with a most distressing human disease. Full information regarding the fly is immediately demanded. We turn to the literature to find it, but discover that as far as the American writings are concerned everything is covered in an aggregate of six to ten pages. It now becomes necessary for the entomologist to study the insect in all its habits and stages.

There are probably many cases in which insects come into important connection with diseases other than as carriers. Take the case of pellagra, for instance. The students of this malady are divided into two very distinct schools: those who believe in the causation by spoiled corn and those who adhere to the theory of insect transmission. If the zeistic school, to which practically all of the Italian investigators belong, should be found to be right, insects would still come into consideration in connection with the deterioration of the corn. In this country, as elsewhere, the injury to corn by insects begins in the field and continues when the harvest is placed in storage. Thus if it is an Aspergillus or a Penecillium that causes the disease, the insects injuring the stored product and starting decay are likely to have some connection with it.

Coöperation Necessary

This subject is one in which coöperation by a number of classes of investigators is indispensable. Everyone must admit that experiments in disease transmission by insects should be conducted coöperatively by entomological and medical men. Neither class can do the best work and obtain definite results without loss of time unless the other one works shoulder to shoulder with it. In this respect, however, medical entomology does not differ from other departments of the science. In spraying work, for instance, the entomologist necessarily coöperates with the chemist and horticulturist. In the medical work he must coöperate with the clinician, the bacteriologist and the protozoölogist, but the share of the work devolving upon the entomologist in one case is certainly as great as in the other.

The recent excellent work of Brues, Sheppard and Rosenau is an example of the rapid progress that can be made and the satisfactory results that can be obtained when the proper coöperation of the two interests concerned is established. The same advantage is expected in the present work of the Bureau of Entomology on the possible transmission of pellagra by insects. Messrs. A. H. Jennings and W. V. King, who are engaged in this investigation, have conducted their studies in the closest coöperation with the Thompson-McFadden Pellagra Commission of the New York Post-Graduate School of Medicine headed by Capt. J. F. Siler, of the Army Medical Corps, who, by his work in Italy and elsewhere, has become one of the foremost students of the disease.

Importance of Medical Entomology in the United States

One very recent event which has caused medical entomology to become of more direct concern to the people of the United States is our territorial expansion. We now have the Hawaiian Islands, the Philippines, Guam, Porto Rico and the Canal Zone. In these possessions many of the insect-borne diseases which do not occur within the United States proper are known to exist. Military and commercial interests cause intimate intercourse between this country and the outlying possessions. This naturally has the effect of greatly increasing the importance of full knowledge regarding any insects which may transmit these diseases if they become introduced.

However, the great importance of insects concerned in the transmission of disease, from the American standpoint, is not connected with tropical maladies which may be introduced and become epidemic here, but with a number of important endemic diseases. In the case of man we have malaria, dengue, spotted fever, a form of ophthalmia,

typhoid fever, tuberculosis, leprosy, poliomyelitis, dysentery and other diseases in which insects are known to be concerned. In the case of diseases of domestic animals we have splenetic fever of cattle, and there is a strong suspicion that infectious anemia of horses is transmitted by *Stomoxys calcitrans*, to say nothing of the possible presence within our boundary also of spirillosis of fowls transmitted in other countries by a tick which is very common in the Southwest.

In the group of exotic diseases of man we have yellow fever, plague, cholera and others. Our public health service is wide awake and efficient, but the impossiblity of preventing the invasion of our country by exotic diseases is shown by the presence of plague in California and the outbreak of yellow fever in New Orleans not later than 1905. As long as it seems to be humanly impossible to prevent the invasion of such diseases, the study of the native insects which can transmit them will require investigation.

The danger of the introduction of new diseases in this country is illustrated in a case of shipment of Indian cattle which was brought to New York a few years ago. In order to be safeguarded, a veterinarian accompanied the importer to India where he made repeated blood examinations of every animal that was selected. Such care is not exercised with human immigrants. The examinations were continued while the cattle were en route. As an extra precaution the animals were kept at quarantine off the harbor at New York for some weeks. Here it was found that the trypanosome which is the causative agent in surra was present. It is not difficult to imagine similar cases in which diseases might pass through the quarantine. In the case of surra, for instance, we have a number of species of insects that can carry it from one animal to another. In fact, we have one of the identical species, *Stomoxys calcitrans*, which has been proven to be a transmitter of this malady in the Philippines and elsewhere.

Narrowing our inquiry we will now consider the four specific diseases of man and one of cattle occurring in the United States, which, as far as known, are transmitted only by insects. These are malaria, dengue, spotted fever, typhus, and splenetic fever of cattle.

Very recently students of conservation have furnished data that lead to much greater exactness in the determination of the losses caused by human diseases than was formerly possible. The most notable work of this kind has been done by Prof. I. Fisher of Yale University. As the result of most careful calculations he has concluded that the average economic value of the lives now sacrificed by preventable diseases is $1,700. He has also estimated in certain cases the loss due to invalidism not resulting in death. These determina-

tions have been used as a basis in certain calculations we have made but in the case of malaria we find reliable figures already available.

Dr. L. O. Howard has made a very careful and conservative estimate of the loss to the United States due to malaria. His conclusion is that $100,000,000 per year is a fair estimate. The writer's studies have convinced him that this estimate is extremely conservative. If the full effects of the depreciation of land values due to the presence of mosquitoes and the hindrance to development were to be taken into consideration the figures would have to be raised considerably.

Spotted fever causes about fifty deaths per year and there are about four hundred cases of invalidism not resulting in death. On the basis mentioned, the deaths represent a money value of $85,000 and the invalidism $15,000, or a total of $100,000 annually.

Rather exact estimates of the losses due to splenetic fever of cattle have been made. A very reasonable figure which has been practically agreed upon by a number of investigators is $100,000,000 per year.

The other diseases included in the list of those transmitted solely by insects, namely, typhus and dengue, are not covered by absolutely definite statistics at the present time. In case of dengue it is probable that many cases are included in the reports on malaria. Typhus fever is of no great importance although it is probable that a surprising number of cases will be found in the cities that receive a large inflow of immigrants from Europe and Mexico as a recent publication of the Public Health Service shows that Brill's disease is nothing but typhus. In view of the absence of exact statistics it had been considered best to discard these two diseases for the present.

To summarize the losses due to diseases transmitted exclusively by insects, for which statistics are available, we have:

Malaria	$100,000,000
Spotted fever	100,000
Splenetic fever	100,000,000
Total	$200,100,000

We now proceed to a number of important diseases which are not transmitted exclusively by insects, but by them to a greater or lesser extent. These are: tuberculosis, typhoid fever, enteritis and diarrhea and dysentery. The most important of these is tuberculosis which, according to Professor Fisher's statistics, causes a total loss to the people of the United States of over $1,000,000,000 annually. There are no data available, as far as the writer knows, which would give a definite basis for estimating the proportion of deaths from tuberculosis which are chargeable to insects. Recent work on the longevity

of the tubercle bacillus throws considerable light on the likelihood of insect transmission. It has been found, for example, that the longevity of the organism increases enormously as the environment changes from light and dry to dark and moist. In other words, the highest longevity occurs in exactly such places as are best adapted for the breeding of the house fly. We consider that in all probability one twentieth of the cases are contracted through the agency of insects. We, therefore, have a probable annual loss in the United States of $50,000,000 due to insects in connection with tuberculosis.

In the case of typhoid fever, considering that one fifth of the loss is due to insects, we have a total of $70,000,000 per year.

In the group of enteritis and diarrhea no estimate of the total loss seems to have been made. From the census report covering the years 1900 to 1904 we find that the number of deaths per 100,000 from these diseases was 112.8. The death loss for the United States, on the basis of life value of $1,700, would be $178,000,000 annually. To this we judge there must be added at least an equal amount of loss on account of invalidism. We consider that one tenth of the loss may be due to insects. This gives a total of $35,000,000 per annum chargeable to insects in connection with these diseases.

In the same way we conclude that the losses due to insects that are concerned in the carriage of dysentery amount to $2,800,000 per year.

In making the estimate of the cost of invalidism due to enteritis and diarrhea and dysentery we believe that we are more than conservative. In the cases of the three important diseases; namely, malaria, tuberculosis and typhoid fever, for which statistics are available, the total loss is eight times the death loss, but in these instances we have estimated the total loss as only double the death loss.

We may summarize the losses due to the two classes of insects which we have discussed, as follows:

Malaria	$100,000,000
Splenetic fever	100,000,000
Spotted fever	100,000
Tuberculosis	50,000,000
Typhoid fever	70,000,000
Enteritis and diarrhea	35,000,000
Dysentery	2,800,000
Total	$357,900,000

We are certain that in making our estimates we have leaned far towards the side of conservatism. For the moment we have not considered poliomyelitis, pellagra and several other maladies at all, and other expenses chargeable to insects have been omitted. Take, for

example, the expenses arising from quarantines. The precautions that are taken against the introduction of yellow fever, cholera and other epidemic diseases are large, to say nothing of the expense of the control of plague which is already introduced in this country.

It must also be borne in mind that we are only beginning to acquire definite knowledge regarding insects which transmit diseases. The extent to which this is done in cases where something is known about transmission is probably greater than we believe, and, moreover, we must consider the possible discovery of insect causation of diseases which are not at present included in the category of those borne by insects at all. It was but yesterday that the connection between poliomyelitis and the stable fly was discovered and no one knows what addition to our knowledge will be made tomorrow.

The extent to which the importance of insect disease transmitters seems certain to increase can be realized by considering poliomyelitis. The statistics relating to this disease are very unsatisfactory on account of the apparently great increase in the number of cases within the last few years. The latest statistics available give the deaths from this malady in 1909 as 569 in the registration area of the United States which represented at that time 55.3% of the total population of the United States (*Frost Public Health Bulletin* 44, page 8). The same authority gives statistics which indicate an average death rate of 7.7% If we estimate the number of cases from the non-registration area in proportion to those in the registration area in the United States (it may be incorrect on account of the greater occurrence of the disease in the northeastern part of the country where practically all of the states are in the registration class), and use the mortality rate mentioned, we find an annual loss for the United States in the value of lives of $1,734,000. The 13,000 cases of invalidism suggested by these statistics would represent a money loss of $10,404,000, or a total from the disease of $12,138,000. If insect transmission transpires to be as important as the work of Brues and others indicate, at least one tenth of the cases may originate through the attacks of *Stomoxys calcitrans*. This would add over a million dollars annual loss to the estimate we have given.

In all of these estimates we have omitted, altogether, an important group of incidental expenses that is chargeable to insects. This concerns the warfare that is waged throughout the country against numerous species which are merely nuisances and not, as far as known, concerned in the transmission of diseases. The house fly and various non-pathogenic mosquitoes are combated by various mechanical devices, such as screening, the expense of which, as Doctor Howard has pointed out, probably aggregates ten million dollars annually.

In addition to this charge the amount expended in lotions and such preparations must be very considerable.

Agricultural and Vital Losses Compared

We are in now a position to compare the losses due to insects which carry diseases with those which affect the crops grown in the United States. The most complete account of the total losses caused by insects to farm products with which we are familiar is that of Mr. C. L. Marlatt in his paper in the Yearbook of the Department of Agriculture for 1904. He estimated a total loss of $795,100,000. Our estimate of the losses caused by disease transmitted by insects is approximately one half as great as that caused to all farm products. It is altogether likely that the actual losses will very nearly equal those occurring with farm products. Surely this is a sufficient argument for greater attention to medical entomology.

A few comparisons are of striking interest. The codling moth, according to Mr. Marlatt's estimate, causes an annual loss in the United States of $20,000,000, or only a fifth of that due to the insects connected with either malaria or tuberculosis transmission. The loss due to the Hessian fly varies greatly from year to year but is estimated as averaging about $40,000,000, less than one half that occurring in the case of malaria. The damage to all the cereal crops in the United States is only equal to that occurring in tuberculosis and malaria combined, while the damage to natural forests and forest products is estimated to be the same as that in either malaria or tuberculosis.

To obtain a foundation for the comparison we have made we have attempted conservatively to reduce the loss in human life to a pecuniary basis. Although this may have been useful in impressing the point, it really does an injustice to medical entomology. The two branches are radically different in one important respect. One deals with material losses and the other with a reduction in the vital force of the nation. Is it right to compare the loss of a human life with the loss of 28 bales of cotton or 1700 bushels of wheat? The loss in cotton or wheat might be made good in another region or during another season, but for the life that is lost there is no compensation. The recent developments, therefore, bring a new interest into entomology and also give to the entomologist a portion of the respect and honor which has always been given the physician on account of his work in saving and prolonging life.

Extent of Present Work on Medical Entomology in the United States

We now come to the question of how extensively entomologists in this country have occupied the field of medical entomology. The present membership of this Association is 359. Perhaps a score out of this number, that is, 5 per cent, are more or less concerned with medical entomology. This number includes those who teach medical entomology in connection with other branches of the subject, as well as others who have administrative work on many species affecting agricultural products and minor projects connected with disease transmitting species. In all probability the time put in on the subject by all entomologists in this country who have anything whatever to do with the medical side of entomology would not be more than equivalent to the full time of ten members, or 2 per cent of the Association. We shall consider, however, that an equivalent of full time of 5 per cent of the membership is engaged in this way. It has been pointed out that the losses to the people of the United States caused by insects aggregate at least one half of the losses to agricultural products. On this basis, if entomologists covered the field of medical entomology as thoroughly as they do that of agricultural entomology in this country, there would be 169 engaged altogether in that line of work. Out of 154 projects included in the report of the committee on entomological investigations, only eight deal in any sense with medical entomology. These are distributed over only six states, one of them having two projects of the kind and each of the others one. Could there be a more striking illustration of the neglect of our opportunities?

There is one point the writer desires to make in order to obviate a possible misconstruction of his position. We have compared medical and agricultural entomology and have contrasted the amount of work in each field which is now under way in this country. Much as we urge the necessity of more work in medical entomology, we do not desire to see it undertaken at the cost of a reduction in the work on agricultural entomology. Possibly there are a few cases in which the work on agricultural pests might be curtailed, as, for instance, where stations in neighboring states have similar projects on the same species, but the writer believes in the idea expressed repeatedly by the lamented Dr. John B. Smith, that many men with their different viewpoints might well be employed on the same project, and that there is hardly such a thing as useless duplication in entomological problems. Moreover, one discovery opens new fields. Coquillett's work on cyanogen did not settle the question of fumigation, but led to a host of problems about dosage, plant susceptibility and procedure. The devising of a plan of campaign against a pest leads to the necessity of demonstrations

for the benefit of farmers. Thus the field of agricultural entomology is far from being covered adequately. But along with agricultural entomology, and in no way interfering with it, there should develop a medical entomology of a magnitude in some degree commensurate with its importance.

Conclusion

Applied entomology is a science of recent development. We are working in a new country and with a multiplicity of important pests. We have no occasion to be dissatisfied with the progress that has been made. The facts that the science has recently developed, that the forces at work have been far from adequate, that the majority of entomologists are engaged by institutions devoted to advancing agriculture in a rather strict sense, and that medical entomology is a domain that has only recently been opened, are the reasons for the comparative neglect of the subject. The work that confronts us now is to survey that domain and occupy it. Humanity and the destiny of economic entomology demand that we do so.

List of Principal Works Consulted

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Vice-President Headlee: In accordance with the provisions of the Constitution discussion on this address will go over until the next session, and I will now retire from the chair in favor of the President.

President W. D. Hunter: We will now proceed with the reading of the papers on the program, and I will call for the paper by Mr. George A. Dean on "Further Data on Heat as a Means of Controlling Mill Insects."

FURTHER DATA ON HEAT AS A MEANS OF CONTROLLING MILL INSECTS.

By Prof. George A. Dean, *Entomologist, Kansas State Agricultural College and Experiment Station*

Two years ago the writer read a paper before this Association on "heat as a means of controlling mill insects." At that time, although the heat method had been used successfully in one or two flour mills, it was still in the experimental stage. However, within the last two years this method has been so developed that now a large number of mill men are satisfied that it is the only practical and efficient method at present known of completely controlling all classes of mill-infesting insects. In Kansas the heating of more than twenty mills has absolutely proven that no stage of an insect, even in the most inaccessible places, could withstand the heat, and several flour mills in Ohio, Illinois, Indiana, Iowa, Nebraska, southern Canada, and elsewhere, have corroborated the practicability and the efficiency of heat as a means of controlling mill insects.

If a mill is infested with the several stages of the confused flour beetle (*Tribolium confusum*), and the other little rust red flour beetles, the cadell (*Tenebrioides mauritanicus*), and the sawtoothed grain beetle (*Silvanus surinamensis*), the treatment heretofore used is of little value, for these insects are found in cracks and in accumulations of fine stuffs inaccessible to any gas. After one has visited flour mills throughout this country, and has made inspections of flour arrivals at the principal ports along the Gulf, the Great Lakes, the Atlantic seaboard, and in Europe, he will soon discover that the confused flour beetle and the cadelle, the larval stages of which are causing so much trouble in flour, are found in practically every flour mill in this country, southern Canada, and Europe. After inspecting this flour and the ports of this country and Europe, through which the flour from many of our mills is handled either for domestic or foreign trade, one is not only convinced that it is this class of mill insects that is causing the serious trouble, but that the large majority of the infestations originates at the mills. One will also be convinced that the hydrocyanic acid gas method, as well as others that are in common use, is inadequate and that something more effective must be used if we are going to control this class of insects.

A Brief Summary of the Successful Heating of a Few Mills

No. 1. During the summer of 1910, a 1,000-barrel frame mill in Topeka was given a thorough fumigation with hydrocyanic acid gas.

No mill could have been given a better fumigation with the gas, and yet a few months later this mill was showing evidence of serious insect infestation. The following spring this mill was given a second fumigation with hydrocyanic acid gas. One month later insects were in sufficient numbers to cause trouble. During the month of June, without any change or additional radiation in the heating system of the mill, the heat was turned on one Sunday morning and continued until nearly Sunday midnight. The examination the next day showed that far more insects were killed than in the gas fumigations, and inasmuch as the examination several months later failed to reveal a single live Mediterranean flour moth in any stage, the manager of the mill was satisfied that it was a far more effective and practical method. Later additional radiation was installed in this mill, and it now has a most effective system.

No. 2. During the summer of 1910, a 1,500-barrel mill of Wellington, Kansas, was fumigated with hydrocyanic acid gas. The expense of the fumigation was over $225, which does not include the shut-down of three days. Before the summer season had passed, not only the common mill insects were again becoming abundant, but the Mediterranean flour moth was doing serious injury. The following summer after installing additional radiation at an expense of not more than that of one fumigation, the mill was heated from Sunday morning until Sunday midnight. A careful examination the next day showed that no insect escaped death on the floors where the heat ranged from 115° to 130° F. No part of the mill was injured by the heat. The examination one year later showed that the Mediterranean flour moth was completely eradicated. The president of the milling company said of the heating method, "I am confident that the method is a great success. We find that after subjecting our mill to heat for eighteen hours, not a creature which was exposed to the heat lived."

Heating of Mills in Ohio.[1] Professor Gossard, entomologist of the Ohio Agricultural Experiment Station, in his annual report for the year 1911, recommends the heat as a practical and a most efficient method, and speaks of several mills in which the heat was used successfully. The millers in his state who have used heat are convinced that it is the cheapest and the most effectual method for the control of mill insects. In Bulletin No. 234 of the Ohio Agricultural Experiment Station Mr. W. G. Goodwin, the assistant entomologist, makes the following summary relative to the heat method:

"It is the most thorough method of treatment for the control of insects infesting flour mills; it requires but one treatment per year to

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[1]Annual Report of the Entomologist, Ohio Agr. Exp. Sta., 1911.

completely rid the mill of insect pests and no preliminary cleaning is necessary.

"It is not dangerous to human life as are all of the other fumigants which are even fairly effective.

"There is no possibility of injuring floors, belts, or machines, and practically no danger from fire.

"The cost of a treatment, after the heating system is installed, is less than one fiftieth of that of hydrocyanic acid gas fumigation.

"No time is lost in getting ready to use heat. The mill does not need to be shut down several days beforehand, and as most of the Ohio flour mills use steam power, the cost of a heating system would not be prohibitive. High temperature, as compared with other methods of treatment, by saving time and extra expense, will pay for the average heating system required in a flour mill in less than five years."

Government Recommends the Heat Method.[1] During the summer of 1911, the United States Department of Agriculture had one of the experts of the Bureau of Entomology stationed in the southeastern part of the United States to carry on experiments for the control of mill insects in rice and peanut mills. In a recent publication of the results of these experiments, the Government has approved of the heat method and recommends it as a most efficient method in the control of insects in this class of mills.

The Amount of Radiation Required

The number of square feet of radiation surface required to heat a given number of cubic feet depends upon the condition and the construction of the building, the number of windows and doors on each floor, the character of the machinery, and the location of the steam pipes. Usually one square foot of radiation is sufficient to heat from 50–100 cubic feet of space. A mill that has sufficient radiation to heat it in winter to a temperature of 70° without the heat of the running machinery, can readily be heated in summer to a temperature of from 120–125°.

If the mill is a five-story building, the writer would suggest for the first floor one square foot of radiation to 50 cubic feet of space; for the second floor one square foot to 60 cubic feet; for the third floor one square foot to 75 cubic feet; for the fourth floor one square foot to 90 cubic feet; and for the fifth floor one square foot to 110 cubic feet. If the building is four story, one square foot of radiation to 50, 60, 75, and 100 cubic feet of space for the first, second, third, and fourth floors respectively is recommended.

[1]Cir. No. 142, Bureau of Entomology, U. S. Dept. of Agr.

TABLE SHOWING THE RADIATING SURFACE PER LINEAR FOOT, AND THE LINEAR FEET OF PIPE REQUIRED TO MAKE ONE SQUARE FOOT OF RADIATING SURFACE

Size of pipe in inches	Radiating surface per linear foot	Linear feet of pipe per square foot of radiating surface
1	0.346	2.9
$1\frac{1}{4}$	0.434	2.3
$1\frac{1}{2}$	0.494	2.0
2	0.622	1.6
$2\frac{1}{2}$	0 753	1.3

In case steam pipe is used for the radiation, either one and one-fourth or one and one-half inch pipe is recommended as the most practical size.

Some Very Important Points to be Considered in the Successful Heating of a Mill

1. The steam pipes should be located near the floor and so arranged as to give an equal distribution of heat.
2. There should be a water trap to draw off all water accumulating in the pipes.
3. The lower floors and the floors with heavy machinery should have more radiating surface in proportion to the cubic feet of space to be heated than the upper floors and the floors with the light machinery.
4. The steam should be turned on with 25–50 pounds pressure, so as to heat the mill more rapidly.
5. In order to take advantage of the heat in the machinery, the heat should be turned on immediately after shutting down the mill.
6. Stairways and elevator shafts should be closed, so as to make each floor entirely separate.
7. Two or three thermometers should be distributed on each floor in order to know what temperatures you have.
8. Time must be taken to reach the desired temperature.
9. A temperature of from 118° to 125° is sufficient for any part of the mill.
10. This temperature should be held several hours to allow the heat to penetrate all the infested parts.
11. Do not attempt to heat a mill on a windy, a cold, or a rainy day.

The Effect of Heat Fumigation Upon Flour

In connection with heat fumigation, the question naturally arises as to whether the heat would have any deleterious effect upon the baking quality of the flour. To give data upon this subject baking tests were made of a patent hard-wheat flour, a low grade hard-wheat

flour, and a pancake flour. These flours were subjected to a heat several degrees higher than that recommended for a mill. The low grade hard-wheat flour was not only subjected to a temperature of 140° for nine hours, but the same samples were reheated to the same temperature two and six weeks later to ascertain whether a second and third heating of the same flour would have any injurious effect. The pancake flour was subjected to a temperature of 130° for forty-eight hours. The baking tests of all these experiments showed conclusively that the heat had absolutely no deleterious effect upon the baking qualities of the flours.

Some Uncalled for Criticisms

The objection made by some that the insurance companies will not permit heat is without any foundation. The only instances of an objection of this sort that has been brought to the attention of the writer was in case of mills that may be equipped with the automatic sprinkling system. Mr. William Reed, secretary of the Mutual Fire Prevention Bureau, representing eight of the principal millers' insurance companies, in a recent notice to all policyholders makes the following statement: "We propose to advocate the heating systems for effective fumigation against the Mediterranean flour moth, weevil, and all other mill and grain infesting insects." The objection that the system is not practical because of the impossibility of heating in winter is one scarcely worth considering. No one is advocating the heating of a mill in winter. Any one familiar with the insect infestation of a mill knows that if a mill is heated during the latter part of the summer and all the insects killed, there will be no necessity for heating during winter months. The objection that heat will injure the belting, check the elevator legs and the woodwork of the bolters and purifiers is without a semblance of truth. In one experiment the mill was heated far above the required temperatures, some of the temperatures going as high as 150° F., for a period of nearly thirty hours, and the examination showed absolutely no injury to any part of the mill or the mill machinery.

Summary of Results

In a mill, flour accumulates in recesses and insects breed in places inaccessible to the gas or vapor of any fumigating material, but heat passes through all of these obstructions and penetrates the innermost recesses! Many mill insects do not yield readily to hydrocyanic acid gas, but no mill insect can withstand for any length of time a temperature of from 118° to 122° F. The writer has fumigated many mills

with hydrocyanic acid gas, but in no case has the fumigation with gas proven so successful as the heating of several mills. In the heating of these mills it has been demonstrated that the heat is the most practical, efficient, convenient and least expensive method. To fumigate with hydrocyanic acid gas requires from two to three days, and this long shut down with the additional cost of material is a large item of expense, besides an element of danger to the operator, while with heat, since it can be applied from Saturday evening until Monday morning, there is no loss of time, very little expense, and no danger to the life of the operator.

TEMPERATURE RECORDS AND OTHER DATA OF SOME MILLS THAT HAVE USED HEAT SUCCESSFULLY

R. E. Kidder Flour Mills, Kansas City, Kansas

Capacity of mills, 600 barrels.
Building, brick.
Date of heating, July 7–8, 1912.
Character of day, partly cloudy and calm.
Outside maximum temperature, 91 degrees.
Outside minimum temperature, 73 degrees.
Heating system, steam pipes along the wall, except in space beneath the first floor where radiators are used.
Steam pressure maintained during the heating, about 20 pounds.

First Floor

Capacity of floor, 28,728 cu. ft. Amount of radiation 525 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m., 7-7-12	83	90	86
11.30 a. m.	83	94	88
12.30 p. m.	84	98	91
2.30 p. m.	88	104	96
3.30 p. m.	90	106	100
4.30 p. m.	93	107	102
5.30 p. m.	94	110	103
7.00 p. m.	95	110	107
8.30 p. m.	97	113	108
9.30 p. m.	98	115	108
9.00 a. m. 7-8-12	100	122	117
11.00 a. m.	106	124	116
12.00 m.	106	125	118
2.00 p. m.	106	128	118
4.00 p. m.	107	129	120
5.30 p. m.	108	129	121

Location of Thermometers

No. 1. In 2 inches of flour in elevator boot on floor 8 feet beneath steam pipes.
No. 2. Hanging in middle of room 5 feet high, 15 feet from steam pipes.
No. 3. In 2 inches of flour in elevator boot on floor, 12 feet from steam pipes.
Result: Failed to reach killing temperatures in elevator boots on the floor, except directly over radiators in space beneath the floor. Killing temperatures reached in all other parts of the room.

Second Floor

Capacity of floor, 28,728 cu. ft. Amount of radiation 560 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	98	97	99
11.30 a. m.	105	97	106
12.30 p. m.	110	98	111
2.30 p. m.	117	100	118
3.30 p. m.	120	102	121
4.30 p. m.	123	104	123
5.30 p. m.	125	105	125
7.00 p. m.	127	108	127
8.30 p. m.	129	109	129
9.30 p. m.	130	111	129
9.00 a. m. 7-8-12	140	122	140
11.00 a. m.	142	125	142
12.00 m.	144	126	144
2.00 p. m.	144	127	144
4.00 p. m.	147	129	147
5.30 p. m.	146	131	145

Location of Thermometers

No. 1. Hanging in open 4 feet high, 15 feet from steam pipes.
No. 2. Between rolls in roller, 11 feet from steam pipes.
No. 3. Hanging in open 6 feet high near roller machinery.
Results: One hundred per cent of the insects were killed.

Third Floor

Capacity of floor 3,112 cu. ft. Amount of radiation 460 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	95	85	89
11.30 a. m.	100	88	91
12.30 p. m.	105	91	95
2.30 p. m.	114	100	102
3.30 p. m.	116	102	103
4.30 p. m.	119	105	107
5.30 p. m.	122	107	108
7.00 p. m.	124	111	111
8.30 p. m.	126	113	113
9.30 p. m	127	114	114
9.00 a. m. 7-8-12	133	126	125
11.00 a. m.	138	127	125
12.00 m.	139	127	126
2.00 p. m.	141	128	128
4.00 p. m.	143	128	131
5.30 p. m.	145	129	131

Location of Thermometers

No. 1. Hanging in open 5 feet high, 15 feet from steam pipes.
No. 2. In flour in conveyor near floor, 12 feet from steam pipes.
No. 3. In flour in conveyor 6 feet high, 15 feet from steam pipes.
Results: One hundred per cent of the iusects were killed.

Fourth Floor

Capacity of floor, 43,092 cu. ft. Amount of radiation 400 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
10.30 a. m. 7-7-12	96	88	88
11.30 a. m.	100	90	90
12.30 p. m.	105	92	91
2.30 p. m.	114	99	97
3.30 p. m.	116	101	99
4.30 a. m.	118	103	101
5.30 p. m.	120	106	103
7.00 p. m.	122	109	106
8.30 p. m.	120	111	109
9.30 p. m.	122	112	110
9.00 a. m. 7-8-12	127	118	117
11.00 p. m.	129	119	118
12.00 m.	132	120	119
2.00 p. m.	133	121	120
4.00 p. m.	138	122	122
5.30 p. m.	138	124	122

Location of Thermometers

No. 1. Hanging in open 5 feet high, 12 feet from steam pipes.
No. 2. In flour in conveyor near floor, 12 feet from steam pipes.
No. 3. In flour in conveyor near floor, 12 feet from steam pipes.
Results: One hundred per cent of the insects were killed.

Hunter Milling Company, Wellington, Kansas.

Capacity of mill, 1,000 barrels.
Building, brick.
Date of heating, July 21, 1912.
Character of day, partly cloudy and calm.
Outside maximum temperature, 97 degrees.
Outside minimum temperature, 74 degrees.
Heating system, steam pipes along wall and a few radiators.
Steam pressure maintained during the heating, about 100 pounds.

Basement

Capacity of floor 33,790 cu. ft. Amount of radiation 1,020 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers			
	No. 1	No. 2	No. 3	No. 4
	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	96	128	98	98
10.00 a. m.	97	134	104	98
12.00 m.	100	136	105	98
2.00 p. m.	102	136	107	102
4.00 p. m.	104	138	108	106
6.00 p. m.	103	140	109	109
8.00 p. m.	103	143	109	109
10.30 p. m.	102	145	113	109

Location of Thermometers

No. 1. In flour in elevator boot resting on floor 5 feet from steam pipes.
No. 2. Hanging in open 6 feet high, 10 feet from steam pipes.
No. 3. In flour in elevator boot resting on floor 15 feet from steam pipes.
No. 4. In flour in elevator boot resting on floor 10 feet from steam pipes.
Result: Killing temperatures were not reached in elevator boots resting on the concrete floor.

First Floor

Capacity of floor, 40,040 cu. ft. Amount of radiation 780 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a.m.	130	121	97
10.00 a.m.	138	123	100
12.00 m.	140	123	102
2.00 p.m	140	124	108
4.00 p.m.	142	125	111
5.00 p.m.	143	127	113
10.30 p.m.	146	131	119

Location of Thermometers

No. 1. Hanging in open 6 feet high, 15 feet from steam pipes.
No. 2. In flour in roll, 20 feet from steam pipes.
No. 3. In flour in roll in cleaning room, 5 feet from radiator.
Result: One hundred per cent of the insects were killed.

Second Floor

Capacity of floor, 43,120 cu. ft. Amount of Radiation 800 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a.m.	137	112	110
10.00 a.m.	144	119	113
12.00 m.	147	122	115
2.00 p.m.	151	127	121
4.00 p.m.	153	130	124
6.00 p.m.	153	128	126
8.00 p.m.	154	128	128
10 30 p.m.	156	130	129

Location of Thermometers

No. 1. Hanging in open 6 feet high, 15 feet from steam pipes.
No. 2. In flour in bottom of elevator boot, 15 feet from steam pipes.
No. 3. In flour on bolting cloth in reel, 12 feet from radiation (cleaning room).
Result: One hundred per cent of the insects were killed.

Third Floor

Capacity of floor, 43,120 cu. ft. Amount of radiation 900 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers		
	No. 1	No. 2	No. 3
	Degrees	Degrees	Degrees
8.00 a. m.	120	108	116
10.00 a. m.	126	114	121
12.00 m.	131	116	125
2.00 p. m.	136	120	130
4.00 p. m.	138	123	132
6.00 p. m.	139	124	134
8.00 p. m.	141	127	136
10.30 p. m.	142	129	138

Location of Thermometers

No. 1. Hanging in open 5 feet high, 12 feet from steam pipes.
No. 2. In flour in conveyor 14 feet from steam pipes.
No. 3. Hanging in open 5 feet high, 10 feet from radiator (cleaning room)
Result: One hundred per cent of the insects were killed.

Texas

Capacity of floor, 5,100 cu. ft. Amount of radiation, none.

READING OF THERMOMETERS

Time of day	Thermometers	
	No. 1	No. 2
	Degrees	Degrees
8.00 a. m.	121	109
10.00 a. m.	129	113
12.00 m.	134	117
2.00 p. m.	138	121
4.00 p. m.	141	124
6.00 p. m.	141	126
8.00 p. m.	141	128
10.30 p. m.	141	130

Location of Thermometers

No. 1. Hanging in open 6 feet high.
No. 2. In flour in conveyor near floor.
Result: One hundred per cent of the insects were killed.

Inter-Ocean Mills, Topeka, Kansas.

Capacity of mill, 1,000 barrels.
Building, frame.
Date of heating, July 28, 1912.
Character of day, partly cloudy and light breeze.
Outside maximum temperature, 95 degrees.
Outside minimum temperature, 72 degrees.
Heating system, steam pipes along the wall.
Steam pressure maintained during the heating, about 80 pounds.

First Floor

Capacity of floor, 34,790 cu. ft. Amount of radiation, 262 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	98	96	105	90		
10.00 a. m.	104	101	109	94	96	110
12.00 m.	110	106	108	97	104	113
2.00 p. m.	114	111	108	102	105	117
4.00 p. m.	118	115	110	107	108	120
6.00 p. m.	120	116	110	110	110	122
8.00 p. m.	121	117	112	113	112	123
9.30 p. m.	121	118	113	114	112	126

Location of Thermometers

No. 1. Hanging in open 5 feet high, 15 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 18 feet from steam pipes.
No. 3. Resting on roll, 12 feet from steam pipes.
No. 4. In two inches of flour near floor, 5 feet from steam pipes.
No. 5. In flour in conveyor near floor 20 feet from steam pipes.
No. 6. Hanging in open 6 feet high, 20 feet from steam pipes.
Results: Ninety to ninety-five per cent of the insects were killed.

Second Floor

Capacity of floor, 38,269 cu. ft. Amount of radiation 190 sq. ft.

READING OF THERMOMETERS

Time of day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	96	94	93	92		
10.00 a. m.	102	100	93	94	120	94
12.00 m.	108	104	95	99	128	97
2.00 p. m.	114	112	99	104	134	100
4.00 p. m.	118	115	103	107	139	106
6.00 p. m.	120	118	106	108	142	106
8.00 p. m.	122	118	110	110	143	108
9.30 p. m.	122	119	110	112	144	110

Location of Thermometers

No. 1. Hanging in open 5 feet high, 22 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 18 feet from steam pipes.
No. 3. In three inches of bran near floor, 5 feet from steam pipes.
No. 4. In flour in elevator boot resting on floor, 17 feet from steam pipes.
No. 5. In oven in laboratory 5 feet high and three feet from steam pipes.
No. 6. In flour in elevator boot resting on floor, 30 feet from steam pipes.
Result: Ninety-five to one hundred per cent of insects were killed.

Third Floor

Capacity of floor, 49,375 cu. ft. Amount of radiation 267 sq. ft.

READING OF THERMOMETERS

Time of Day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
8.00 a. m.	98	95	94	96		
10.00 a. m.	104	101	100	98	96	102
12.00 m.	109	106	104	104	100	99
2.00 p. m.	115	112	108	108	104	103
4.00 p. m.	120	117	112	112	108	108
6.00 p. m.	124	121	116	116	112	112
8.00 p. m.	126	123	119	118	114	115
9.30 p. m.	127	124	120	122	116	114

Location of Thermometers

No. 1. Hanging in open, 5 feet high, 22 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 20 feet from steam pipes.
No. 3. In flour in conveyor 6 feet high, 8 feet from steam pipes.
No. 4. In flour in purifier 4 feet high, 13 feet from steam pipes.
No. 5. In flour in elevator boot resting on floor 4 feet from steam pipes.
No. 6. In flour in conveyor near floor, 11 feet from steam pipes.
Results: One hundred per cent of the insects were killed.

Fourth Floor

Capacity of floor (including deck) 69,580 cu. ft. Amount of radiation 310 sq. ft.

READING OF THERMOMETERS

Time of Day	Thermometers					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
	Degrees	Degrees	Degrees	Degrees	Degrees	Degrees
9.00 a. m.	101	98	93	94	97	
10.00 a. m.	103	100	95	96	92	
12.00 m.	110	107	102	100	98	
2.00 p. m.	116	114	107	102	100	
4.00 p. m.	122	120	113	106	105	
6.00 p. m.	126	123	116	110	109	
8.00 p. m.	126	123	118	115	113	
9.30 p. m.	127	124	118	114	113	

Location of Thermometers

No. 1. Hanging in open 5 feet high, 26 feet from steam pipes.
No. 2. Hanging in open 5 feet high, 28 feet from steam pipes.
No. 3. In flour in elevator boot 6 inches from floor, 24 feet from steam pipes.
No. 4. In flour in conveyor near floor, 13 feet from steam pipes.
No. 5. In flour in conveyor near floor, 22 feet from steam pipes.
Result: One hundred per cent of the insects were killed.

Deck (or fifth floor)

Capacity included in measurement of fourth floor. Amount of radiation none.

READING OF THERMOMETERS

Time of day	Thermometers No. 1	Thermometers No. 2
	Degrees	Degrees
9.00 a. m.	104	100
10.00 a. m.	106	99
12.00 m.	114	112
2.00 p. m.	122	113
4.00 p. m.	126	118
6.00 p. m.	128	123
8.00 p. m.	127	125
9.30 p. m.	127	126

Location of Thermometers

No. 1. Hanging in open 5 feet from floor.
No. 2. In flour in conveyor near floor.
Results: One hundred per cent of the insects were killed.

PRESIDENT W. D. HUNTER: Is there any discussion on this paper?

MR. F. L. WASHBURN: Mr. Dean states the matter correctly when he says that hydrocyanic acid gas does not penetrate well. In spite of this, however, it seems to be a very good remedy, although it is not perfect. I would like to ask Mr. Dean the cost of piping an average sized mill.

MR. G. A. DEAN: In case the mill is using steam power and there is no steam radiation in the mill, it would cost in a 1,000-barrel mill from $500 to $600 to install a good heating system. The installation can be done by the mill men. There should be sufficient radiation to heat the mill to a temperature of 70 degrees during winter weather.

MR. F. L. WASHBURN: Don't you think that the average millman would object to spending that much money?

MR. G. A. DEAN: Inasmuch as a mill with a capacity of from 600 to 1,000 barrels will have on an average more than $100,000 capital

invested, I can not believe there would be any objection to the expense, especially if they can count on the complete control of the infesting insects.

Mr. F. L. Washburn: If a housekeeper, who is reasonably clean, finds insects in the flour should not the blame in eight cases out of ten be placed on the mill from which the flour came?

Mr. G. A. Dean: In nine cases out of ten the infestation can be traced either to the mill or the grocery warehouse in which the flour has been stored.

Mr. Wilmon Newell: At what temperature will snout beetles in flour mills be destroyed?

Mr. G. A. Dean: They cannot stand a temperature of 119 degrees for more than two or three minutes. Of course, snout beetles are not serious pests in flour mills. However, in our heating of mills we have often noticed that they are all killed in those parts of the mill near the intake of the grain, which are about the only places where they are found.

Mr. Wilmon Newell: I asked the question because there are often large numbers of these insects in rice mills and the method of destroying them with heat would, I think, be of value. The injury caused by insects to stored rice is so great that the owners would not hesitate to spend a thousand dollars a season to destroy them.

Mr. W. H. Goodwin: I think there is an important point which Mr. Dean did not mention and that is that it is best to begin heating the mill in the evening. By beginning the work at this time a fatal temperature is reached the next day, usually between 10 and 11 o'clock. One trouble that I have found is that it is almost impossible to maintain a high temperature after 5 or 6 o'clock in the evening owing to the gradual decrease in the temperature outside. This statement applies especially to conditions in Ohio where the ranges of temperature between afternoon and midnight are often very great.

Mr. F. L. Washburn: I should like to ask Mr. Goodwin to express his opinion on the value of hydrocyanic acid gas.

Mr. W. H. Goodwin: I believe hydrocyanic acid gas is of little practical value as a mill fumigant. In all my experiences with this gas in fumigating mills I have not had one perfectly effective result. In every case enough insects survived to reinfest the mill. The gas seems to condense so rapidly that it fails to be effective and the insects are either uninjured or recover rapidly after being subjected to fumigation.

Mr. T. J. Headlee: In regard to the effect of high temperatures on insect life I desire to report that in the past two or three months

we have experimented with the leather beetle, *Dermestes vulpinus* Fab., and found that 125 degrees F. killed the insects without harm to the books which they were infesting.

Mr. W. E. Britton: Can insects be destroyed in warehouses where seeds and grains are kept by using heat?

Mr. G. A. Dean: I would not recommend heat for killing insects infesting stored seeds and grain. In case they are stored in small quantities, the heat method would be entirely satisfactory, but if stored in large quantities it would require too much heat in order to penetrate to the center of the bins. The germination of the grain next to the heat would be injured and perhaps the gluten qualities. We have one or two mills that are planning to heat their grain in their elevators by passing it through a hot-air blast. I do not advocate heat for destroying pests in seed storehouses and grain elevators.

President W. D. Hunter: I will now call for the paper by Mr. Newell, entitled "Notes on the Rice Water Weevil and its Control."

NOTES ON THE RICE WATER WEEVIL (LISSORHOPTRUS SIMPLEX SAY), AND ITS CONTROL

By Wilmon Newell, *College Station, Texas*

The observations here recorded were made by the writer during the summer of 1909, while employed as entomologist of the Louisiana Experiment Stations, and a rather comprehensive report on the investigation was submitted to that Station in February, 1910. Contrary to expectations, it was not published. While a few workers have had access to my unpublished report and notes—and have used them more freely than professional courtesy would sanction—I nevertheless deem the records of sufficient importance to justify their presentation in condensed form before this Association.

Lissorhoptrus simplex is generally distributed, and generally destructive, over the entire rice-growing belt of the South. Thus far the only literature of importance dealing with the insect from an economic standpoint is the article by Doctors Riley and Howard in the Report of the Commissioner of Agriculture for 1881 and 1882, pp. 130–133. In this paper Doctor Howard gave a full account of his investigation of the pest near Savannah, Ga., and described control measures which have been followed, without improvement, to the present time.

In 1906 Mr. W. D. Pierce made mention of injury to rice by this species at Beaumont, Texas, in 1904.[1]

[1]Ann. Rept. Neb. Board of Agr. for 1906–'07, p. 265.

Habits of the Adults. Upon undertaking field investigations in the spring of 1909, I visited various rice-growing localities in search of the insects, but did not find adults in sufficient numbers for satisfactory observation until June 3, on which date I visited a plantation three miles north of Lake Arthur, La. Here I found the adults very abundant in a field of Japan rice about eight inches in height. The irrigating water had been admitted to this field for the first time on June 1, just two days before my arrival and it had not yet reached the higher portions of the field. Here was an average of at least one weevil to every five or six rice plants, but none were found in rice which the water had not yet reached and no larvæ to speak of could be found on the roots of older rice. Some of the adults were swimming about, others were mating and the majority were feeding on the rice leaves.

The weevils are rather sluggish when out of the water, crawling slowly about the leaves of the rice. They can be picked up readily in one's fingers and frequently when touched they will play possum, or "sull," and fall off into the water where they either swim away or continue to "sull" and float on the surface. They cannot be made to take flight, even by throwing them into the air. They swim with great facility and considerable speed, either on the surface of the water or below it, and they apparently find swimming a more convenient means of traveling from one rice plant to another than flying. That they do fly, however, with ease, is shown by their night flights to brilliant lights and doubtless their principal, or sole, means of dissemination from field to field is also by flight.

Feeding Habits. Both the males and females feed upon the rice in an interesting way. The weevil takes a position on the upper surface of the leaf with body parallel to its main axis. The mandibles tear up the epidermis and the operation is assisted by the beak, which is used to push and lift, much as a hog uses its nose for rooting. As feeding progresses the weevil moves forward, feeding, usually, towards the apex of the leaf and makes a feeding scar about as wide as the spread of the mandibles and from 1-16 of an inch to two or more inches in length, depending on the length of time the individual is engaged in feeding. The mandibles do not pierce through the leaf but remove only the epidermis, "skeletonizing" the leaf at the point of feeding. As the leaf grows, or is whipped about by the wind, the skeletonized portion breaks through, making an oval or long slit in the rice blade.

It seems to make no difference, on a reasonably warm day, whether the weevils feed in the sun or in the shade, they being found feeding indiscriminately in both situations. When the day is extremely hot and the sun bright, the weevils show some disposition to avoid the

hottest situations. Thus on June 4, at Crowley, I observed that a much smaller proportion of the weevils were in direct sunlight than at Lake Arthur. When it is hot, also, more of the weevils are found resting along the stems and a larger proportion rest and swim in the water and under its surface.

Feeding is not confined entirely to the leaves. A number of adults were observed to make punctures in the main stem of the rice plant below the water surface. I am satisfied that all weevils observed feeding in this way were females, though the distinction between the two sexes in the field is rather difficult and uncertain except when they are observed *in coitu*. The injury made by the feeding below the water line is quite distinct from that done to the leaves above water. In the former case distinct punctures are made with the beak, not unlike the punctures made in cotton squares by the boll weevil.

Host Plants. Cultivated rice is the preferred host and food plant, and but little difference is noted in choice between Honduras and Japanese types. In general, it may be said that the adults prefer to feed on young plants, rather than on those of advanced size. Infestation of the rice field by the adults is invariably co-incident with the first flooding.

Doctor Howard, in the article referred to, recorded several plants which were fed upon by the adults, particularly wild rice, bulrush, water lily and spatter-dock.

In the course of my Louisiana observations, I found but two food plants and but one true host plant, other than cultivated rice. Wild rice, *Zizania aquatica*, did not, however, come under my observation, and it is to be expected that this is a true host plant.

On June 3, at Lake Arthur, I found the adult weevils feeding as freely upon the leaves of *Paspalum membranaceum* Walt. as upon the rice leaves, with which they were interspersed. The same habit was subsequently observed in all infested fields. Upon another *Paspalum* the adults fed as freely as upon *P. membranaceum* and on June 29 this *Paspalum*, growing in isolation from rice, was found to have its roots heavily infested with the water-weevil larvæ. This *Paspalum* was never positively identified and while apparently different in habit of growth from *membranaceum*, it may possibly be a variety of that species. It is about the first grass to begin growth in spring, occupying drainage ditches, shallow ponds and all places where shallow water is available. It was noticed growing abundantly in the street ditches of Crowley, La., in the spring of 1909. At that time I did not suspicion it of being a host plant of the water-weevil and its roots were not examined for the larvæ.

Attraction to Lights. The adults fly readily to artificial light of all

kinds, especially upon dark, warm nights. Thus on the night of June 4, at Crowley, La., they flew into all rooms where there was any light at all and were so numerous in the hotel bed rooms as to be a nuisance. Going upon the streets, I found them even more abundant and from the plate glass windows of business houses raked them up by hundreds and thousands. It was just at this time that the adults were entering the fields of young rice and there feeding and mating. It seems hardly possible that the thousands of weevils flying to the lights could have been only males and spent females. Weevils captured at the lights and confined in test tubes mated freely. It therefore seems not improbable that lamp trapping just before or during oviposition would possess value as a remedial measure.

Mating. The adult weevils are very precocious and mate at any and all opportunities. Mating takes place, for the most part, on the rice leaves above the water, where the adults are feeding. The mating is done after the usual fashion and frequently two males will be seen attempting to mate with a single female. The males appear to be the more numerous. If violently disturbed the pairs separate, but with gentle handling will not. In one case a pair was observed to remain *in coitu* for eight minutes. When confined in test tubes mating takes place immediately and will occur even after the weevils have been confined for several days. Adults collected around bright lights pair freely.

Difference in Sexes. By observing the weevils *in coitu* in the field it was noticed that, as a general rule, the females were a trifle larger than the males and the dark (or black) area upon the back was more distinct in the case of females than in the males. This difference in coloration is observable only when the insects are submerged and alive. I do not think this character can be made use of at all in separating the sexes when observing dried specimens.

At my request, Mr. W. D. Pierce, of the Bureau of Entomology, made a very close examination of males and females for secondary sexual characters and he was able to determine that in the female the scrobe on the beak, into which the scape of the antenna fits, is slightly curved in female specimens and practically straight in the case of the males. Owing to the natural curvature of the beak this character, while apparently constant, is one difficult to recognize with certainty.

Egg. Obtained by dissection of the female, the egg is found to be pure white, cylindrical, slightly curved and length about five times the diameter. It is barely visible to the naked eye, but can be plainly seen under a half-inch lens. The females have eggs, apparently well developed, in their abdomens at time of mating. I have had no diffi-

culty in taking full-sized eggs from females secured in the act of mating and dissected on the spot.

LARVA. The larvæ of the rice water-weevil are familiarly known to the planters as "rice maggots" and but few are familiar with the adult stage of the insect.

The larvæ eat off the small, tender roots and rootlets and injure the larger, older roots by gnawing into them, or even by eating out a cavity within the root amply large enough to contain the larva itself. Where the root is merely gnawed and not entered, a scar is left which is quite characteristic and which remains visible, probably, until the root dies and decays.

The larvæ are found most abundant where the individual rice plants are smaller and of a yellowish cast, instead of a bright, dark green. When as many as 4 to 8 larvæ (or sometimes 10 to 12) are found on the roots of each plant, the latter will be found to have a yellowish, sickly look, with some of the lower leaves discolored and dead. Plants which have their roots heavily infested come up, when pulled, very easily, in marked contrast to the difficulty experienced in trying to pull up healthy, non-infested plants.

Infested plants are constantly trying to overcome the injury by putting out new rootlets, but as long as the infestation remains heavy these rootlets are in turn destroyed. It is by means of these rootlets that the plants "recover" from the attack, in the language of the rice growers. The plant proper does not really recuperate, however, until the majority of the larvæ have reached maturity and their injury to the rootlets comes to an end. Even in the case of marked "recovery" there can be no doubt but what the productive capacity of the individual plant is severely curtailed.

DURATION OF GENERATIONS. As all my efforts to get the weevils to oviposit in captivity were futile, I could only approximate the duration of larval life by deduction from field conditions.

At the time adult weevils were so abundant in small Japan rice at Lake Arthur on June 3, I examined a field of older Japan rice adjacent. While the adult weevils were very abundant in the small rice, just flooded, they were extremely scarce in the older Japan. A long examination brought to light three partially grown larvæ on the roots of the older Japan, these larvæ being possibly referable to *L. simplex*. A field of early-planted Honduras rice, also near at hand, showed no adult weevils and no root infestation. The roots of both the large Japan and the large Honduras lacked, absolutely, the characteristic feeding scars which are left by the water-weevil larvæ. From these conditions it appeared that the weevils in the younger Japan rice were the ones which would deposit eggs for the first generation on rice.

The great abundance of adults at this time (June 3) seemed to preclude their being hibernated individuals. As stated above, *Paspalum* was shown to be a true host plant and was abundant from very early spring. It seems safe to conclude that the first generation of larvæ are produced upon the roots of *Paspalum* and perhaps other native plants, and that the weevils maturing from these are the ones to infest the young rice in May and early June. The field of rice which was just being flooded, and being occupied by adults for the first time on June 3, was again examined on June 29. At the latter date adults were very scarce but larvæ were found in abundance at the rice roots. The larvæ were all of about the same size and apparently up to maximum size. Some of these larvæ were kept on roots of live rice in cages as late as July 15, by which time they had neither increased in size nor changed to pupæ.

From this data we conclude that from 35 to 45 days elapse from deposition of the egg until completion of the larval stage. I was unable to determine the duration of the pupal stage.

It is not impossible that a third generation is produced upon native host plants, following maturity of the generation on cultivated rice.

Control Measures. The only control measure followed to any extent, during the past thirty years, has consisted in drawing off the irrigating water in an attempt to destroy the larvæ. Among the rice growers themselves there is great diversity of opinion as to the efficiency of this plan. Experienced growers claim full success from the method, while others, equally as experienced, decry it as a dismal failure.

The writer believes that he was the first to detect the surprisingly simple explanation of these diverse results. Briefly stated, this explanation is as follows:

If the injury by the larvæ is in its incipiency and only a small proportion of the roots has been severed, drawing off the water for a reasonable time will destroy the larvæ and, if replaced at the proper time, will not perceptibly interfere with the growth of the plants.

On the other hand, if injury by the weevil larvæ has reached the point where practically all roots are severed, drawing off the water cannot result otherwise than disastrously to the plants for, with no root system except a few small rootlets at the crown, the plants have no way of getting sufficient moisture to continue growth. In such cases injury from drying occurs, far more severe, ordinarily, than the injury done by the larvæ when the water is left on. My examination of a large number of fields in all cases confirmed this explanation.

Every rice grower should be able to distinguish the degree of injury to the plants and determine therefrom whether the water should be

drawn off or whether it should be deepened. In the beginning of injury by the larvæ, judicious removal of the water, and reflooding at the proper time, should be followed. When injury has reached its maximum, removal of the water is disastrous and under such conditions the fields should be kept well flooded.

It should be noted, however, that while excessive flooding may be necessary at times to partially save injured fields, the practice itself does not destroy any of the insects and a continuation of the practice can hardly result otherwise than in a steadily increasing infestation from year to year.

Possibility of Poisoning the Weevils. Mention has been made above of the manner in which the adults feed upon the rice leaves before and during the period of oviposition. This would suggest the possibility of destroying them with arsenical poisons. The water-weevil is, in fact, more of a surface feeder than the plum curculio or boll weevil and some measure of success has attended the use of arsenicals against the latter insects. The ordinary spraying machinery could not be used in a flooded field, but there appears to be no good reason why a powdered arsenical, such as powdered arsenate of lead, could not be distributed from the levees with hand dust-sprayers, advantage being taken of prevailing breezes to distribute it over and across the "cuts." Consideration would of course have to be given to the possibility of the water carrying sufficient of the poison, after leaving the field, to be dangerous to stock.

President W. D. Hunter: As there is no discussion of this paper I will now call for the paper by Mr. Parrott on "New Destructive Insects in New York."

NEW DESTRUCTIVE INSECTS IN NEW YORK

By P. J. Parrott

The agricultural interests of the State of New York sustained large losses during 1912 by the depredations of insects. In variety of species and extent of damage the record has been an unusual one, and in my opinion has not been equalled for many years. While noting the destructive work of the common pests familiar to most entomologists, one also could hardly fail to be impressed with the number of comparatively new insects that came to the front and which, judging from their behavior during this and recent years, are likely to demand serious consideration in the future. It is the purpose of this paper to give brief notes on some of the more important species which have lately attracted our attention.

The Pear Thrips. At the last meeting of this Association mention was made of the occurrence and the destructive work of *Euthrips pyri* Daniel in orchards about Germantown. With the coöperation of Messrs. Blanch and Albright of the Division of Nursery Inspection, through the courtesy of Commissioner Calvin J. Huson, we have determined that the thrips ranges over the Hudson River Valley from Monsey near the New Jersey line to Ravena near Albany. While the insect has done quite a little damage in some orchards on the west side of the river, it has been much more destructive in the region on the east side, running from Hudson to Germantown. In western New York the insect has been found on apples and cherries about Geneva and on pears in the fruit belt running from Rochester to the Niagara River.

While the thrips attacks all of the important tree fruits, it seems to be especially injurious to pears, principally the varieties Kieffer, Seckel and Clapp Favorite. During the spring of 1912 the blighting of blossom clusters in some orchards was very severe and caused a great reduction in fruit yields. Apple trees, while visited by large numbers of the adults, suffered to a much less extent; but dwarfed and curled leaves and occasionally stunted fruits were observed in most orchards. The stems of sweet cherries were especially attractive to the adults for the deposition of the eggs, and they as a rule showed considerable scarification. The effects of this injury upon fruit yields has proven difficult to determine, but our observations this spring led us to believe that the wounding of the stems may cause quite a little loss by the premature dropping of the affected cherries.

The results from the second year's spraying experiments were very satisfactory, and we shall continue to encourage spraying as the most promising means of affording protection to orchards.

The Cherry Sawfly Leaf-Miner. This insect has attracted the attention of cherry growers quite recently and its work has been very conspicuous in plantings about Geneva and Germantown. The pest attacks sour cherries, preferring the variety Morello. The injury is caused by the larvæ of the sawfly which mine the leaves. The attack commences on the edge of the leaf towards the stem. The young larva works along one side towards the apex of the leaf, the tunnel increasing in size with the progress of the insect. Upon reaching the tip of the leaf the grub reverses its course and works back towards the stem, consuming the remainder of the pulpy tissues between the main rib and the margin of the leaf. As a result the interior of the leaf is eaten, leaving the epidermis which turns brown and forms a large blister. These blisters are very conspicuous in the upper surfaces of the leaves. Oftentimes the whole leaf is mined, but usually

with most of the foliage only from one quarter to one half of the leaf is destroyed. The principal damage occurs during the last week of May and the early part of June or about one month before the harvesting of the fruit. The extent of the damage varies with the season and if new growth is not abundant the loss of leaves can hardly fail to affect the yield to an important degree. The sawfly proves to be a new species and it also constitutes the type of a new genus. It has been designated by Dr. A. D. MacGillivray as *Profenusa collaris.*

Polydrosus impressifrons Gyll. We have been watching this species with great interest for several years as its increasing numbers have led us to believe that it is going to develop to be of considerable economic importance. It has become so abundant that during the early summer it is not an uncommon experience to carry the beetles on one's clothes into the home or to observe them on the window screens of buildings. Our attention was first attracted to these insects by their work on young leaves of poplars and willows, and in recent years we have seen them on the foliage of roses, apples and pears. The numbers of the insects would at once suggest to one that they must be causing some harm, but aside from slight injuries to foliage we have never been able to determine just what damage the beetles were causing. During 1912 we observed for the first time an example of their destructive capacity. This was in a large block of willows (*Salix caprea*), grafted to New American, Rosemary and Kilmarnock varieties, which was seriously injured by the beetles feeding on the young buds of the grafts so that they failed to grow.

So far we have obtained very little information regarding the work of this species in its normal habitat for it does not seem to have attracted much attention in Europe aside from systematic workers. Schilsky says that it is quite common in Germany, and Zimmerman states that in Austria the beetles are not numerous enough to be destructive. Giard intimates that it is a common but not an important insect in Europe. It apparently prefers buds and tender leaves, a habit which is shared by many closely related species, as *Polydrosus micans* Sch., *P. mali* Fb., *P. sericeus* Gll., *Phyllobius viridicollis* Sch., *Ph. maculicornis* Germ., *Ph. pyri* L., *Ph. oblongus* L., *Ph. argentatus* L., and *Ph. calcaratus* Sch., which have been more closely studied in Europe. The fact that *impressifrons* is apparently of little significance abroad does not warrant the conclusion that it will prove of no importance in this country. In fact we believe that the beetles are already more numerous here than in Europe or more attention would surely have been given to the species.

Apple and Cherry Ermine Moths. At the twenty-second annual meeting of this Association mention was made of the importations of

Yponomeuta caterpillars in the United States in shipments of foreign nursery stock. Since the discovery of these insects special precautions have been taken by the agents of the Division of Nursery Inspection of the New York Department of Agriculture with plantations of imported seedlings, and during the past four years infested plants have been detected in thirteen localities in the state. According to the reports of the nursery inspectors over nine hundred colonies of caterpillars have been collected. From some of this material we have bred two species of moths—*Yponomeuta malinellus* Zell., which thrives largely on apple, and *Y. padellus* L., which is a more general feeder; showing preference for hawthorn, plum and cherry. Both species are common and destructive fruit pests in Europe.

Careful inspections of nursery plantations and the surroundings of nurseries indicate that these lepidopterons have not gained a footing in New York. In states where there has not been such inspection the danger that such has taken place is obviously great. With the ability of these insects to survive the conditions incidental to the importation of nursery stock from abroad and to escape ordinary nursery inspection, the wonder is that they have not before this succeeded in establishing themselves along the avenues of trade in America.

The False Tarnished Plant-Bug. During some seasons pears in New York are subject to a diseased condition, characterized by the cracking open of the skin in small spots and the formation of protruding granular areas. Fruits seriously affected are usually much deformed and undersized. The nature of the causal agent appears to have been little understood or not definitely known, although some writers have held that the tarnished plant bug (*Lygus pratensis* L.) is responsible for such injuries. Recent studies by us have shown that the scarring of the pears is due to the work of a closely-related species (*Lygus invitus* Say). The damage is done principally by the nymphs which attack both the fruit and foliage of pears. The same species also seeks grape blossoms and punctures the stems as well as the pedicels of the blossoms and fruits, causing imperfect clusters of grapes. In some orchards about Pavilion and Lockport this capsid has been responsible for losses in yields fully as large as those by the pear psylla, which is a great "bug-bear" to most pear growers in this state.

In recent years the work of various capsids on apple and pear fruits has been increasingly conspicuous. In addition to *L. invitus*, we have also observed the nymphs of *Campylomma verbasci* Meyer and *Paracalocoris colon* Say puncturing young pears soon after the dropping of blossoms. The red bugs (*Heterocordylus malinus* Reut. and *Lygidea mendax* Reut.) are doing considerable damage in many apple orchards

by destroying young apples or causing the fruit to be deformed so that it is unmarketable. The destructive work of these insects during 1912 would indicate that they are going to become a serious item for economic consideration.

The Gipsy Moth. Last in this list of the new destructive insects of New York and more important than all is the Gipsy Moth (*Porthetria dispar* L.) which was discovered by W. J. Schoene of the Geneva Experiment Station on June 22, 1912. An announcement of the occurrence of this insect in this state and some of the circumstances of the infestation were given in the Journal of Economic Entomology, Vol. 5, p. 371. It now appears that this pest was largely confined to a few old apple trees in the rear of several residences. No efforts have been spared by the agents of the New York Department of Agriculture to suppress the pest, and it is expected that with the vigorous measures that are being employed it should be exterminated. According to Mr. G. G. Atwood of the Bureau of Horticulture and Nursery Inspection, the presence of this species in the residential section of this city appears to be due to importations of nursery stock which was unpacked in the immediate vicinity of the fruit trees. According to him the infestation was probably started by not more than one mass of eggs, and is not more than three years old. He reports that about eighteen hundred caterpillars, five hundred pupae or pupal cases and twenty moths were collected and destroyed. In the discovery, for the first time, of a colony of the Gipsy Moth in the western portion of the State and not in the region adjoining Massachusetts, that which was little expected has happened. One may well wonder if the pest does not exist in other localities and has so far escaped attention because of the unfamiliarity of local observers with its appearance and importance.

President W. D. Hunter: This paper is now open for discussion.

Mr. H. J. Quayle: I am much interested in that part of the paper referring to the pear thrips. I would like to ask what experiments have been carried on for the control of this insect.

Mr. P. J. Parrott: In reply I will say that at the New York Experiment Station, we have been conducting experiments, and in this work we have used Black-Leaf 40 with soap or kerosene emulsion, making two sprays from the time the buds burst until the blossom clusters open. In New York State the spring advances rapidly and the buds open very quickly—much more so, I am informed, than in California. My impression is that this problem will be a more simple one than in that state. Spraying for the pest is, nevertheless, expen-

sive, and we are now trying to work out a spraying schedule for pears to control the thrips, San José scale, and Psylla, and simplify the work of spraying.

Mr. W. W. Yothers: Have you used distillate oil in place of kerosene emulsion?

Mr. P. J. Parrott: No; we have used kerosene emulsion exclusively—made according to the Government formula.

Mr. T. J. Headlee: For the sake of more efficient inspection of nursery stock I would like to ask how the ermine moth may be recognized, as it comes in on nursery stock.

Mr. P. J. Parrott: The moths have been imported into this country on seedling apple and cherry trees. The egg masses resemble somewhat immature lecanium scale and they are usually found near the buds. The New York Inspectors have been carefully instructed as to how to make examinations in order to detect them, but I do not believe it is possible for them to find all the egg masses that come in the shipments. The best way to control this pest is by inspecting the plantations of nursery stock during the latter part of May and early June, and destroying the plants that show the webs or tents of the insect.

Mr. H. A. Gossard: What I wish to say at this time does not perhaps relate to the interesting paper presented by Mr. Parrott, but it is suggested by it. It was formerly the custom of the U. S. Bureau of Entomology to publish, in the Yearbook of the Department of Agriculture, a review of the more important insect phenomena for the year, so that by reading it one could obtain in a short time a bird's-eye-view of all the important economic happenings in entomology for the whole country for the season. I presume that the abridgment of the Yearbook has compelled the Bureau to drop this feature, although I for one believe this was one of the most important parts of the Yearbook. At present we are obliged to read a large number of State reports and papers similar to the one just given, in order to get this information. The Bureau of Entomology is better fitted than any other agency to furnish this information and I believe that this Association should take the matter up and see if it will not be possible to have these reviews furnished, and published in the Journal of Economic Entomology.

Mr. F. L. Washburn: I believe this idea is a very good one, but would suggest that the subject be referred to the Committee on Resolutions for consideration and action.

President W. D. Hunter: If there is no objection this matter will be so referred.

Adjournment.

Morning session, Thursday, January 2, 10 a. m.

PRESIDENT W. D. HUNTER called first vice-president Headlee to preside.

VICE-PRESIDENT HEADLEE: We will now take up the discussion of the Presidential address.

MR. R. A. COOLEY: Mr. Chairman, I am very sure that we all found the President's address of much interest. It showed evidence of thoroughness and a grasp of the growing question of medical entomology. I might predict that our present Association will soon be divided into two sections; one on agricultural entomology; and one on medical entomology. I believe that this will be the natural course of events and that workers in the latter branch will turn back in years to come and see that this meeting formed the corner stone for such an organization. I was particularly interested in the President's outline of the functions of medical entomology. Many of us who do work of this sort will find questions arising in relation to this and other related branches of science, and we can always turn to this address as a logical statement of the facts. Figures based on such investigations as those outlined, must naturally convince us that we have in medical entomology a subject which will soon develop into one of the main branches of economic entomology. I feel sure that we as a profession should feel very grateful for this paper which will doubtless become a classic.

MR. W. E. BRITTON: I feel very grateful to Mr. Hunter for presenting such an interesting paper. I wish that some arrangement might be made for having a large number of reprints made to be distributed throughout the country in libraries and journals, so that it will have a wider distribution than if published in our journal alone; because I think that people are becoming much interested in papers of this sort. I would be very much pleased to see the paper distributed in this form. Again I wish to thank Mr. Hunter for his admirable address.

MR. T. B. SYMONS: Unfortunately, I was not able to hear the paper by Mr. Hunter, but we all appreciate this work. I have been thinking that possibly it might be well for this Association to have one joint session with Section K, and that this might bring us in closer touch with medical work which is being done. It seems to me that the closer we can coöperate along this line, the better it will be for all concerned.

VICE-PRESIDENT T. J. HEADLEE: I have seldom had the pleasure of listening to such a logical and interesting address as the one delivered by our President. It clearly shows that the time is at hand when medical entomology will be considered as important as agricultural entomology, and that perhaps in the future it may even surpass

it in its hold on the attention of our people. States like New Jersey in which the urban population is a very large part of the whole and in which farming land is being rapidly transformed into suburban residence property, medical entomology is particularly needed.

If there is no further discussion I will now pass the chairmanship over to President W. D. Hunter.

President W. D. Hunter: The first paper of this session will be presented by Mr. Henry H. P. Severin on "The Mediterranean Fruit Fly."

PRECAUTIONS TAKEN AND THE DANGER OF INTRODUCING THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.) INTO THE UNITED STATES

Henry H. P. Severin, *Honorary Fellow, University of Wisconsin*

Cargo: The chief dangers of introducing the Mediterranean fruit fly into the United States is through ships carrying cargo, ship stores, export fruit and baggage into our coast ports. With such a large coast line as we have on the western boundary of the United States dotted with harbors, it is interesting to know what precautions are taken to keep this serious pest out of California, Oregon and Washington. On the California coast every ship coming from a *foreign port* must first enter one of the five ports of entry, and report to the United States Customs. Each ship, upon its arrival at one of these ports of entry, finds in waiting, one or more horticultural quarantine officers who together with the customs' men examine the horticultural products on board and the baggage of the passengers. Each vessel upon its arrival, must furnish a manifest, itemizing all horticultural products carried in the vessel as freight and indicating the nature, extent and origin of such material. The inspector having this information some time in advance of the actual landing of such imports, can take proper precautions for their inspection, treatment and final disposition. Practically the only horticultural imports arriving from Honolulu to the ports of entry are pineapples, bananas and root crops, all other crops being quarantined against under the Plant Quarantine Act (Quarantine Notice No. 2).

One Californian, after having studied the fruit fly situation in the Hawaiian Islands on returning to San Francisco, observed that the steamer on which he was traveling docked just a half hour later than another which came from the Orient. He wondered how three (now six) horticultural quarantine officers could search a steamer thoroughly

in half an hour, and be ready to inspect the steamer on which he was traveling in so short a time. The first steamer came from the Orient via Honolulu and as soon as the federal health officer lowered the quarantine flag, one horticultural quarantine official and three or more customs' men boarded the ship which they met in the open sea in a launch and began to search the ship's stores, the steerage lockers, the steerage galleys, the forecastle galleys, etc. As this steamship sailed from a foreign port, and docked at San Francisco, forty or more customs' men began to search the travelers' baggage. Whenever these customs' men found a horticultural product of any kind they held the same until a quarantine officer examined it. The horticultural officers received a special manifest setting forth every article of horticultural product that was on the ship. The manifest was taken to the dock agent and the horticultural products were marked on this list and could not be removed from the dock until searched. One horticultural officer has boarded the next steamer and as it approaches the dock, the two remaining quarantine officers hurry to meet this steamer. This steamer happened to be sailing between two *domestic ports, i. e.*, Honolulu and San Francisco. The United States Customs' men do not search ships plying between domestic ports and the quarantine officers must, therefore, perform all of this work. There are two steamship companies running steamers between Honolulu and San Francisco and every one of these ships is absolutely dependent upon the quarantine officers for examination.

What about other ports along California, Oregon and Washington coasts where no quarantine is being maintained? Sailing vessels from Honolulu and other Hawaiian ports sail to California, Oregon, and Washington ports. And again, what about Australian steamers which stop at Honolulu and then proceed to Vancouver? Shipments by rail or by Pacific coasts steamers from these ports would be a constant danger of distributing infested fruit from the Hawaiian Islands. In connection with the oil ports in California the ship owners have issued an order to the captains of all their vessels on September 8, 1911, which reads as follows: "From now on it will be against the rules of this company for you or any of your crew to bring ashore any fruits that are put on board your vessels at Honolulu. Any infringement of this will mean expulsion." Under the Plant Quarantine Act it is unlawful for these sailing vessels to receive for transportation from Honolulu any quarantined fruits or vegetables. British Columbia has placed a complete quarantine against any kind of fruit from the Hawaiian Islands.

Ships' Stores: An arrangement has been made with ship owners that all fruits and vegetables purchased at Honolulu for ships' stores

should be thrown overboard before entering California water, *i. e.*, before or arriving at the three-mile limit. Even this is a dangerous method to pursue for Gurney of New South Wales immersed the Mediterranean fruit fly maggots in sea water for a period of forty-five hours and a large percentage of these maggots developed into adult flies. Notwithstanding the promises of ship owners that the remnants of all fruits and vegetables purchased at Honolulu for ships' stores should be thrown overboard before their vessels enter California waters, the quarantine officers, during the month of May, 1912, found living larvæ of the Mediterranean fruit fly and melon fly in eleven different instances in this class of stores on board ships arriving from Honolulu. The quarantine officers then threatened to hold at anchor, away from the docks, all ships arriving from infested ports until they were declared free from insect pests. The reaction of this stimulus brought about the desired effect for no more infested fruits or vegetables were found in the ships' stores on the Honolulian steamers since.

Export Fruits from the Hawaiian Islands: Let us take up next the danger of sending export fruits from the Hawaiian Islands into the United States. On June 24, 1911, California placed a quarantine against all Hawaiian fruits excepting pineapples and bananas. On October 1, 1912, the Plant Quarantine Act went into effect, the Secretary of Agriculture having followed the footsteps of California in quarantining all the Hawaiian fruits, except pineapples and bananas.

In the last number of the Journal of Economic Entomology No. 6, pages 443–451, we published a paper entitled, "Will the Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) Breed in Bananas under Artificial and Field Conditions?" There is no question or doubt but that the Mediterranean fruit fly will occasionally breed in ripe and overripe bananas under Hawaiian conditions. The fruit fly was also bred from a half ripe banana under field conditions.

A number of entomologists have bred the Mediterranean fruit fly from pineapples and bananas under natural conditions. Kirk of New Zealand has actually bred the Mediterranean fruit fly from pineapples and bananas intercepted at the wharf. French of Victoria has also reared the pest from pineapples and bananas, and on many occasions he has proven "eggs to have been deposited in green bananas."

What precautions were taken at Honolulu to prevent the Mediterranean fruit fly from entering the United States through export pineapples and bananas? On March 1, 1912, the marketing division of Honolulu took entire control of shipping export fruits. An inspector was employed who visited the various banana plantations and inspected the bananas. He was not to pass bunches containing scale infested bananas nor ripe, partly ripe or injured bananas. The

bunches of bananas were marked in the field and later tagged, and arrangements were made with the steamship companies that no untagged fruits or vegetables were to be shipped to California. The material used in packing pineapples and bananas was changed from grass, in which there was a possible danger of the pest to pupate, to rice and excelsior. The wagons carrying the packed bananas were to be covered with canvass to prevent any maggots from dropping on the load while driving below fruit trees through the streets of Honolulu.

What precautions are taken at San Francisco regarding pineapples and bananas entering California from Honolulu? At a meeting of the California quarantine officials on June 7, 1912, it was decided to burn the wrapping material around bananas shipped from Honolulu, but whether this good intention is being carried out at present I am not able to state. All fresh pineapples destined for California points are fumigated heavily as a matter of insurance before they leave the dock. At San Francisco a man is especially detailed to make a thorough inspection of banana imports on the dock and to inspect fruits in the store-rooms of the commission districts.

With all the evidence showing that the Mediterranean fruit fly has been bred from pineapples and bananas, you may wonder why California did not follow the footsteps of British Columbia and place a complete quarantine against all Hawaiian fruits. At a meeting of the quarantine officials at Sacramento, the California representative who had been stationed in Honolulu admitted that California was taking *a chance in allowing pineapples and bananas to enter the state.* After discussing the fruit fly situation for six hours with the California quarantine officers, it was fully decided to put an absolute quarantine against the Hawaiian Islands. At a meeting of a fruit fly committee in connection with the California state fruit growers' convention held at Santa Barbara on June 13, 1912, this question was put to me, "If there is a choice between (1) a complete quarantine against the Hawaiian Islands and (2) to stop the inspection of baggage, which would you recommend on the strength of the greater danger of the Mediterranean fruit fly entering the state of California through these two sources?" I replied that the greater danger would rest in infested fruit being carried in the baggage.

Baggage: The most dangerous loophole through which the Mediterranean fruit fly may gain entrance into the United States consists in the fact that the California quarantine officers have no legal right to search baggage. When a passenger at Honolulu goes aboard a steamer coming from a foreign port, his trunk is sealed at Honolulu and the customs' men do not search this sealed trunk at San Francisco, but only search his hand baggage. The United States Cus-

toms' men have no authority to search baggage on any steamer sailing between domestic ports, for instance, between Honolulu and San Francisco. As already stated there are two steamship companies which carry passengers on steamers sailing between the Hawaiian Islands and San Francisco. The horticultural quarantine officials search hand baggage of passengers traveling on these ships, and yet these officers have no national law to give them the power to do so. The privilege was acquired through the coöperation of these two steamship companies with the California quarantine department. On each ticket good for passage from Honolulu to San Francisco, an agreement is stamped whereby the purchaser of the ticket agrees to submit all of his baggage to the inspection of the horticultural officers before leaving the docks at San Francisco. This agreement went into effect on June 17, 1911.

When I arrived in San Francisco on June 6, 1912, from Honolulu on one of the steamers sailing between these domestic ports, all passengers' hand baggage was searched by the horticultural quarantine officers but not a single trunk was inspected by these officials. A passenger could have taken to any city in the United States, 350 pounds of Hawaiian grown fruit in his trunk, or even more if he cared to pay excess baggage. The greatest danger then, of introducing the pest into almost any place in the United States rests with the travelers, making a trip from the Hawaiian Islands to the United States and who may carry Hawaiian grown fruits in their trunks into California and out of this state. In most cases, fruit would be carried by passengers not familiar with the danger of introducing this pest but from reports that I have received in Honolulu, there are some people who have returned to Honolulu from the mainland and who delight to say they have "beaten" the horticultural quarantine officers and have taken fruit to their friends, or for their own use, in the United States. This of course, is second-hand data but Maskew, chief deputy quarantine officer of California, in his April report, 1912, writes, "In the matter of passengers' baggage, fruit fly material was detected and destroyed in fifteen instances among those arriving by the various lines during the month," from Honolulu.

In Honolulu an inspector visits the fruit markets daily and he is empowered to seize any fruit, melon or vegetable that is infested by the fruit fly and offered for sale. This reduces somewhat the danger that tourists, coming from the Orient and stopping for a day or two, will buy infested fruit during their stop-over; but this does not prevent travelers, who remain in the islands for some time, or individuals who live in Hawaii and occasionally visit the mainland, from buying infested fruits from peddlers. Every day a Chinaman carrying two large

baskets loaded with fruits and vegetables makes a house to house canvass and offers, often badly infested, fruit for sale. These Chinamen will take orders for large amounts of fruits and deliver the same to your door. How easy it would be for the unthinking, traveling public to buy fruit from these peddlers and pack the same in a trunk to take to their friends or for their own use on the mainland!

President W. D. Hunter: Is there any discussion on this paper?

Mr. C. L. Marlatt: I am very glad to have listened to Mr. Severin's paper and I think he is correct in many things that he has said, but he is a little behind the times as to some things and he is not altogether fair in speaking of control measures. I spent one month in Hawaii and during that time I was very busy seeing all that was possible of the fruit fly throughout the islands of Hawaii. Human effort is never perfect. Nursery stock is sent to every place in the United States and the success of the Federal Plant law depends on the individual inspectors. A law rests on the character of the individual who enforces it. The authorities in Honolulu have undoubtedly done the best they could. When I was there the city was as clean as a dollar and there was no affected fruit noticeable. It is true, there was not much fruit when I was there, and the season that Mr. Severin speaks of is the season when the fruit is most abundant, when hundreds of barrels fall from the trees every night and the conditions are necessarily at their worst. No doubt the conditions when Mr. Severin was there are correctly described but somewhat wrongly interpreted. The inspection at the San Francisco end is a further check, and the fruit is prohibited at British Columbia. The protection elsewhere along the coast is pretty good. If there is a single bad or broken fruit the inspectors at San Francisco reject it. You can find good and bad in any question, but in this instance the balance is distinctly on the right side. The experimental testing of food products is to be very carefully done, and if we find that there is danger from bananas the federal quarantine will be extended to this fruit. California has not been lenient in letting things in; she has rather gone to the other extreme and carried her quarantines beyond the actual needs. Bananas and pineapples are inspected now by federal officers in Hawaii, and that inspection is repeated at San Francisco. No doubt it is true that some officers have not been absolutely above suspicion, but that is one of the things we have to come in contact with always in human nature. The paper points out one side rather than the other. We are improving the situation as fast as we can, and I think the people who have been affected by this quarantine have accepted it with splendid spirit. There has not been a bit of hesitation in establishing safeguards, and

I think there is a good deal to be said in commendation. The work that Mr. Severin did is much to his credit, but you cannot blame people for resenting criticism when they are doing the best they can. I am sorry that Mr. Severin's work was interrupted. It was very interesting and has added much to our knowledge of the fly.

President W. D. Hunter: The next paper will be presented by Mr. C. H. Hadley, Jr., on "A City's Attempt to Trap Brown-tail Moths."

A CITY'S ATTEMPT TO TRAP BROWN-TAIL MOTHS

By C. H. Hadley, Jr., *Durham, N. H.*

(Paper not received for publication.)

Mr. F. L. Washburn: I should like to have you give some data on the relative number of male and female noctuid moths, which came to the lights.

Mr. C. H. Hadley, Jr.: We secured no data on the number of noctuid moths.

Mr. A. F. Burgess: In connection with the data given in this paper I will say that during the summer of 1910 a series of experiments was conducted in Reading, Mass., for the purpose of determining the percentage of male and female brown-tail moths that could be trapped at arc lights. In all thirteen separate lights were used and the experiments were carried on throughout the month of July. A considerable variation occurs in the number of the sexes secured during different times in this month. In 1910 the first moths were caught July 1 and the last ones July 29. Over 78,000 were secured and these were preserved and carefully examined during the winter; 71 per cent. of the insects were males and of the females only 2/10 per cent. had deposited their eggs. At these trap-lights large numbers of other insects were secured. An interesting feature was that a very large percentage of the female tent caterpillar moths, that were secured in the traps, had already deposited their eggs. I cannot give the relative percentage of male and female noctuid moths which were obtained, although I think we have some data on this subject.

Mr. P. J. Parrott: Is this trap considered a promising method for general use?

Mr. A. F. Burgess: Most of the traps which we used consisted of a pan in which was placed water and a small amount of oil. The labor of cleaning these every day was considerable and we did not think they were a practical method of control.

President W. D. Hunter: The next paper, "The Results of Experiments in Controlling the Gipsy Moth by Removing its Favorite Food Plants," will be read by Mr. A. F. Burgess.

RESULTS OF EXPERIMENTS IN CONTROLLING THE GIPSY MOTH BY REMOVING ITS FAVORITE FOOD PLANTS

By A. F. Burgess and D. M. Rogers, *Boston, Mass.*

For many years great effort has been made to bring to perfection the mechanical methods for controlling the gipsy moth. Aside from the work of introducing the parasitic and predatory enemies of this insect, experiments along the line of perfecting methods of control have occupied a great share of the attention of the government and state officials in charge of the moth work and of various investigators and observers connected with it. In the earlier writings concerning the feeding habits of gipsy moth caterpillars and in the experiments which were conducted to test their ability to feed on the foliage of the native tree growth of New England, the conclusion was reached that this insect was a general feeder and that practically all the trees or plants concerned would suffer severe injury on account of being defoliated by the larvæ. In fact, during the period when the territory in the suburbs of Boston was the worst infested, about the years 1904 to 1906, large woodland areas were completely defoliated owing to the enormous number and voracity of the caterpillars.

Early in 1907 it was noticed that in many places, where the gipsy moth defoliation had been severe, that the larvæ seemed to show some preference in the species of trees attacked. It was also observed that white and pitch pine did not appear to be severely defoliated unless they were growing in or near an area of hardwood trees. Realizing the importance of this matter Mr. A. H. Kirkland, then superintendent of the Moth Work for the state of Massachusetts, detailed Mr. F. H. Mosher to carry on a series of laboratory experiments to test the feeding of newly hatched gipsy moth caterpillars on pine foliage. These were carried on during the spring of 1907 and were repeated the following spring. Mr. Mosher failed to rear first stage caterpillars on this food. In the spring of 1908 an extensive field test was made, using a clear stand of about five acres of white pine growth in Arlington, Mass. This experiment was carried on coöperatively between the Massachusetts superintendent of Moth Work and Mr. D. M. Rogers of the U. S. Bureau of Entomology. The locality was badly infested and the trees on the border about 100 feet deep, were banded with tanglefoot in order to prevent caterpillars from crawling into the

area. No other treatment was applied and no injury resulted to the trees.

During the following two years observations were made on the feeding habits of the gipsy moth caterpillars by various observers, and in 1910, when bulletin No. 87 of the Bureau of Entomology was published, covering a report of the field work against the gipsy and brown-tail moths, enough information had been secured so that the authors felt warranted in making the following statements.

On page 14 it is stated that the gipsy moth has a varied list of food plants, "in fact, it will eat almost any kind of vegetation, although it seems to prefer the foliage of oaks, willows, and apple trees. Repeated observations have shown that the ash, juniper, and red cedar are practically immune from attack, while the maple is not injured to any great extent if more desirable food is within easy reach." As a result of these observations it was recommended, pages 73 and 74, that "owners of woodland on which the trees are of marketable size should cut the timber if the gipsy moth is prevalent in the region. Care should be taken in doing this work to cut out all poor and worthless trees, and if possible to leave for reforesting purposes, vigorous specimens of ash, maple, pine, or coniferous trees of which the insect is not especially fond and which can be protected with the least possible expense. The planting or preservation of ash and hickory is recommended as the wood is of high value and these trees are not subject to attack by the brown-tail moth. Planting pine or other coniferous trees for reforesting purposes is also advisable, as the region is suited to their growth and these can be protected from moth injury at slight expense. It is probable that many of the forests containing oak or other trees which are preferred by these insects must in time give way to species less subject to attack. In the meantime the owner should take advantage of the opportunity to harvest his merchantable trees that are susceptible to attack and foster the growth of other species that will not be destroyed."

After the publication of this bulletin more observations were made on the food plants of the gipsy moth and Mr. Rogers became so thoroughly convinced of the practical utility of eliminating the trees, which were most favored by this insect, that in the winter of 1910–11 much consideration was given to the subject by him and several experiments were carried on, on a large scale to determine what would happen if forest areas were thinned to solid blocks of species which had frequently been observed to withstand defoliation.

An area was selected near Chelmsford Center, Mass., where the tree growth was chiefly chestnut, with some gray birch and oak, and where the infestation was heavy. Seven acres were used for the

experiment. The oak and all other trees, except chestnut, and a few conifers, were removed and the brush and slash burned. This left a stand of chestnut trees averaging 35 to 45 feet in height, all of which were badly infested. No detailed observations were made during the early summer, but occasional visits by Mr. Rogers during the season failed to indicate any defoliation of the chestnut trees. Since that time the brush and sprouts have been allowed to grow and while the trees have not been injured by caterpillar feeding, the oak sprouts have furnished enough food so that the infestation is slightly greater than it was in the fall of 1911.

During the same winter another block of woodland in Methuen, Mass., covering about twenty-five acres, was thinned as an experiment. One section of this woodlot covering perhaps four acres consisted mainly of white pine with scattering oak trees and undergrowth; the balance consisting of red and white oak, gray and yellow birch and red maple. The latter species was particularly common on the low ground and in some parts of this area several small groups of hemlock trees were growing. The section where pine predominated was thinned to solid white pine growth, while in the oak and maple area all the oaks were cut except a few specimen trees. On the lower land all oaks and birches were removed leaving red maple, and in a few places hemlocks and an occasional pine. A part of the trees growing on the high ground was badly infested and the infestation decreased slightly on the lower ground where more maples were growing. In the spring of 1911 the trees on the higher area were banded with tanglefoot, where this lot joined a badly infested woodlot, but no other treatment was applied and no serious injury resulted except to some of the oaks. The infestation over the entire area decreased remarkably as a result of the thinning. This fall, 1912, practically all of the trees, except the oaks, are in good condition. A slight infestation can be found throughout the entire area but it is apparent that no injury to the trees is likely to result from it. This woodlot has been used as a pasture for cattle so that very little sprout growth exists.

In order to follow up the results of making experimental thinnings and to attempt to secure more information on this important phase of the gipsy moth work, as well as to obtain field data which could be used in connection with an extensive series of laboratory feeding experiments, which were made during the summer of 1912, a number of areas were thinned during the winter of 1911–12 under the direction of the writers.

In Hudson, Mass., an area of chestnut, maple, red and white oak, gray birch and ash, with various kinds of undergrowth which was slightly infested, was thinned to a chestnut stand and all specimens

of maple and ash were allowed to remain. On one side of the area large pines predominated which were mixed with gray birch and an occasional oak. The last two species were removed leaving a pine stand with an occasional maple, chestnut, or ash tree. The brush was cut over the entire area except the seedlings and sprouts of the same species as the trees left standing. No gipsy moth injury has been observed during the summer of 1912, frequent observations having been made by Mr. H. R. Gooch, who had charge of the thinning operations in this and several other selected areas. The infestation appears to be about the same as it was last year. Other areas have been thinned leaving solid pine and hemlock stands and no injury has resulted to the trees during the past summer. In one case a remarkable decrease in the number of egg clusters has been noted, while in the adjoining unthinned block a slight increase has been observed.

It is apparent that it will be necessary for a number of years to pass before the final results of this work can be given, but the information at hand is of such practical importance to owners of woodland that it seems well to make public the results that have been secured. In this connection it should be said that very thorough and detailed observations are being made, both in the field and by means of laboratory tests, to secure exact information on the feeding habits of gipsy moth caterpillars in each stage and on all the food plants which are common to New England. The data secured during the past summer are not yet ready for publication, but the results indicate that the oaks should be eliminated as rapidly as possible from our woodlands.

While they are the chief offenders they are not the only species that should be eliminated. Gray birch is a common species and is of low value as far as the wood is concerned. In some cases it is useful as a nurse crop for pine but its susceptibility to gipsy moth attack renders it a dangerous companion for the latter. Neglected or wild apple and willow trees should be destroyed as they furnish attractive food for the caterpillars. First stage gipsy moth caterpillars do not feed freely on pine or hemlock and the same is true in regard to some of our hardwood trees. In fact, it is exceptional for first stage caterpillars to grow and develop when their diet is confined to certain species. If half-grown or larger caterpillars feed on the same plants a large percentage of them will develop and if the same thing happens in the field where the infestation is at all severe, defoliation by the larger caterpillars often results to species which are not particularly favored as food by the younger larvæ.

From the present data it appears that oaks of all species are the greatest menace to improvement and development of New England forests as far as the gipsy moth is concerned. If these were cut the

injury by this insect would be greatly reduced, and the same holds true with the brown-tail moth. In certain sections the oaks predominate, but the region is suitable for growing white pine, which is far more valuable, and it is becoming apparent that the oaks will be eliminated, either gradually as a result of moth attack and other insect injury or by the efforts of man to bring about a better forest condition which will at the same time serve to hold these destructive pests in check.

Woodland owners outside the moth infested area should interest themselves in the proper care of their woodlots and should eliminate the oak growth as rapidly as possible so that the trees in their forests will not furnish suitable food for the species when it arrives. In the infested woodlot the problem is more pressing and difficult and needs immediate action if great injury is to be prevented.

PRESIDENT W. D. HUNTER: The next paper will be presented by Mr. Glenn W. Herrick.

MR. GLENN W. HERRICK: With the consent of the Association I wish to read at this time a paper on the control of two fruit flies, *Rhagoletis pomonella* and *R. fausta*, as a substitute for the one on the printed program.[1]

ABSTRACT OF PAPER ON THE CHERRY FRUIT FLIES

By GLENN W. HERRICK

The results obtained by Mr. Illingworth in controlling the apple maggots encouraged him to try similar control measures against the closely allied cherry fruit flies.

It was soon discovered that, in addition to the old species, *Rhagoletis cingulata*, another little known species, *Rhagoletis fausta* was present and doing much injury to the fruit. This species had been reported as injurious to cherries in British Columbia in 1907.

The flies were first seen in the orchard on June 8, 1912. They were first seen ovipositing in the field on June 24. The first maggots were found June 30. Full grown larvæ emerged from cherries on July 8. By the middle of July most of the larvæ of *R. fausta* were found to be mature.

The length of life of the flies confined in glass cages was one month. The flies were supplied with drops of water daily and fed with crushed cherries.

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[1] The paper on "Some External Parasites of Domestic Fowls," has been submitted by Professor Herrick for publication and appears below.

Control. A portion of the orchard was sprayed on June 10 just after the flies were seen and again on June 24. No heavy rains fell during the intervening two weeks. A sweetened mixture of $2\frac{1}{2}$ lbs. arsenate of lead, $1\frac{1}{2}$ gals. of cheap syrup, and 50 gals. of water formed the spraying solution. It was applied to the lower branches of each tree by hand.

On July 11, two crates of cherries, containing an average of 6,400 cherries to the crate, were picked from the sprayed portion of the orchard. The first crate, picked from the tops of the trees in the outside sprayed row, contained seventeen maggots. In the crate picked from the lower branches there were only two maggots. A crate of cherries picked from the check trees was badly infested with curculio and brown rot and fully one-third of the fruit contained maggots. The check rows showed less and less infestation the nearer they were to the sprayed trees.

Flies captured, on the check rows next to those sprayed, died in a day or so, showing that they had obtained poison by going over on the sprayed trees.

All the evidence appears to show that the flies are easily poisoned and that they travel from tree to tree for a considerable distance from where they emerge.

There is considerable evidence being gathered to show that the ordinary codling moth spray, without the addition of syrup, will control these flies.

President W. D. Hunter: This paper is now open for discussion.

A Member: I would like to ask if *Rhagoletis cingulata* and *fausta* are in the same orchard.

Mr. G. W. Herrick: Yes; they were found in the same orchard at Trumansburg, N. Y., but this test was tried wholly on *fausta*.

Mr. W. C. O'Kane: Were all the trees infested?

Mr. G. W. Herrick: The fruit in that orchard was, and in two other orchards, it was badly infested.

Mr. W. C. O'Kane: Did all the trees have fruit the previous year?

Mr. G. W. Herrick: I do not know.

Mr. W. C. O'Kane: Do you know whether there was such fruiting and infestation the previous season as to insure an equal amount of flies throughout the orchard?

Mr. G. W. Herrick: The flies were on all the trees.

Mr. W. C. O'Kane: The reason I bring this point up, is because in the work with the apple maggot we have found it necessary to have the yield, the disposition of the fruit, and the amount of infestation

the previous year recorded, in order to draw conclusions from our spraying.

Mr. G. W. Herrick: In this case we do not know definitely except that the crop during the previous year was a failure.

A Member: May I ask if this ground was heavy clay?

Mr. G. W. Herrick: It was clay soil mixed with gravel and quite stony.

A Member: It has been my experience that cherries are not infested so much on clay soil.

Mr. G. W. Herrick: There are a good many cherry trees not far from this orchard, but the latter are rather isolated. The fly does not seem to travel very far. The feeding habits of this species are practically the same as those of the house-fly as given in Dr. Howard's book on this subject. The flies are constantly sucking from the fruit which shows the manner in which they get their food from the fruit and leaves.

SOME EXTERNAL INSECT PARASITES OF DOMESTIC FOWLS

Glenn W. Herrick

Domestic fowls, especially the hen, constitute one of the most important sources of food supplies in America. It is amazing to find that during 1911 the value of poultry in the United States reached a total of $154,663,220 and the value of the eggs produced in the same year in New York State alone amounted to the astonishing sum of 17,102,000 dollars. It is evident that poultry occupies an important place in the life economies of the American people and any pests injuriously affecting domestic fowls are worthy of careful consideration. The study of the external parasites of domestic fowls has extended over several years with many interruptions and delays. It has been difficult to collect the different species infesting fowls and even yet we have not been able to obtain all the species that I feel surely exist in the United States.

According to the different authorities on Mallophaga there are at least eight species infesting the hen, four or five the goose, three or four the turkey, four the duck, four the pea fowl, three the guinea hen, and seven the pigeon.

In addition to the Mallophaga we find that there are in this country at least eighteen species of mites parasitic on the domestic fowl, two species of fleas, one fowl-bug, one tick, and possibly one fly.

Among these parasites the Mallophaga hold the most interest for the author. Some of the most interesting questions of development,

variation, etc., arise out of a consideration of the geographical and host distribution of these parasites. They are wingless insects of world-wide distribution existing wherever members of the bird tribe are found. They are parasites that live for their whole life on the body of their host. They, of course, migrate from one host to another when the hosts are in actual contact, when in copulation; when brooding over the offspring; or when huddling together on perches. Moreover there is occasionally an opportunity for the parasites of a host to actually migrate to a host of another species. For example, we find a certain species of hen louse on the turkey, especially when the two species of domestic fowls are in the same yard. We have also found two species of hen lice on guinea hens where the latter were allowed to frequent the perches and houses of the hens. Kellogg has found the same species of louse on both a cormorant and a pelican shot on the rocky shores of the Pacific Coast where these two species of birds congregated and evidently came in actual contact. But as Kellogg further points out another explanation must be given for the distribution of those species of Mallophaga that are found on birds of the Old World and on closely related birds of the New World. There are many instances of this kind, yet these birds do not come in contact, nor within thousands of miles of each other. Kellogg offers an exceedingly interesting explanation of this phenomenon in distribution. He says, "that the parasitic species has persisted unchanged from the common ancestor of the two or more now distinct but closely allied bird-species." That is to say, these species of Mallophaga existed on the ancestors of the host birds and have persisted ever since without change although their hosts have become modified into different species. This may be explained by the fact that the Mallophaga are surrounded by an environment, namely, the feathers, skin, and temperature of the host, that do not change although the host itself may change. These are not economic questions perhaps but they are intensely interesting ones.

The more important question from an economic point of view is how these parasites injure poultry. The Mallophaga have biting mouth parts and do not suck the blood of their host. In fact, it is doubtful if any of the Mallophaga parasitic on domestic fowls ever get any blood except in case of a wound or bruise on the host from which the blood may issue. In such instances the parasites may eat the dried scales of blood. Blood has been found in some instances in the stomachs of bird lice, probably obtained in the manner just described. Kellogg notes a species of Mallophaga that lives inside of the pouch of the California Brown pelican and clings to the wall of the pouch by its mandibles. Moreover, he has found a small area

surrounding the parasites raw and bloody. It is a question in this case as to what these particular lice eat for food.

It is generally conceded that Mallophaga live upon bits of feathers and scales of the skin. Theobald speaks of them as constantly biting at the skin and causing serious irritation. Other writers hold that the constant movements of the lice cause irritation to the skin by reason of the sharp claws, with which all the feet of these parasites terminate. The presence of the lice sets up an irritation and pruritus that eventually weaken the host and give a chance for various maladies to get hold of the fowl. This seems to be especially true of chicks, where, if the lice are abundant, growth is greatly checked, diarrhœa seems to follow and a general weakened condition may result.

The losses caused by the poultry lice are difficult to estimate but the total must be large. Chickens, when badly infested, fail to make anything like their normal growth. Theobald gives the results of some experiments showing that chicks suffering from lice, at the end of the year, weighed one pound less than those which had been kept free from these pests, both having had exactly the same diet.

The loss in egg production through the infestation of laying hens must be enormous although there is no way of getting even an approximation. Brood-hens are often so irritated by these parasites that many of the failures in hatching must be attributed to the lice. Undoubtedly the presence of the lice, by weakening the general constitutions of their hosts, predisposes the fowls to such diseases as gapes, cholera, roup, etc., and thus contributes to a formidable indirect loss and injury.

List of Mallophaga on Domestic Fowls

The species marked with a * have been collected and are thus known to occur in this country.

On the Hen (*Gallus domesticus*)

**Menopon pallidum* Nitzsch.
**Menopon biseriatum* Piaget.
**Lipeurus heterographus* Nitzsch.
**Lipeurus variabilis* Nitzsch.
Goniodes dissimilis Nitzsch.
Goniodes eynsfordii Theobald.
**Goniocotes gigas* Taschenberg.
**Goniocotes abdominalis* Piaget.
Probably a synonym of *G. gigas*.
**Goniocotes hologaster* Nitzsch.
Goniocotes burnettii Pack.
Probably a synonym of *L. heterographus*.

On the Turkey (*Meleagris gallopavo*)

**Goniodes stylifer* Nitzsch.
**Lipeurus polytrapezius* Nitzsch.
**Menopon biseriatum* Piaget.
Menopon stramineum Nitzsch.
Probably a synonym of *biseriatum*.

On the Goose (*Anser domesticus*)

Lipeurus anseris Gurlt.
**Lipeurus jejunus* Nitzsch.
**Trinoton conspurcatum* Nitzsch.
**Trinoton lituratum* Nitzsch.
**Docophorus icterodes* Nitzsch.

On the Duck (*Anas domesticus*)

**Lipeurus squalidus* Nitzsch.
**Lipeurus heterographus* Nitzsch.
**Docophorus icterodes* Nitzsch.
**Menopon obscurum* Piaget.
**Trinoton luridum* Nitzsch.

On the Pea Fowl (*Pavo cristatus*)

**Menopon phæstomum* Nitzsch.
**Goniodes falcicornis* Nitzsch.
Goniodes parviceps Piaget.
Goniocotes rectangulatus Piaget.

On the Guinea Fowl (*Numida meleagris*)

Menopon numidiæ Denny.
Lipeurus numidiæ Denny.
Goniodes numidianus Denny.
**Goniocotes abdominalis* Piaget.
**Menopon pallidum* Nitzsch.

On the Pigeon (*Columba domestica*)

**Colpocephalum longicaudum* Nitzsch.
**Goniocotes compar* Nitzsch.
**Lipeurus baculus* Nitzsch.
Goniodes damicornis Nitzsch.
Gonoides minor Piaget.
Menopon latum Piaget.
Menopon longicephalum.
**Menopon biseriatum* Piaget.

In addition to the Mallophagan parasites we should like to record the definite occurrence of the hen flea (*Ceratophyllus gallinæ*) more commonly known as *Pulex avium* in this country. Doctor Taschenberg records it from a great variety of birds including domestic fowls but, so far as the writer is aware, it has been recorded from this country but once and that was by Baker in Canad. Ent., Vol. 27, p. 111, under the name *Pulex avium*. This single specimen was contributed by Prof. Herbert Osborn and was collected at Ames, Iowa, but the host was not given.

In the spring of 1912, specimens of this flea were received from Abington, Mass., with an inquiry concerning them and methods of getting rid of them. The specimens were taken from the inside walls and roof of a poultry house but were not collected directly from the fowls. The correspondent informed me that the fleas had bitten her so severely that the bites troubled her for two or three weeks afterwards. The fleas had not been noticed until a few weeks after the purchase of some chickens from a neighbor who had just returned from California. It is thus barely possible that the fleas had been imported from California although the correspondent did not think the neighbor had brought any fowls from that state.

The specimens were submitted to Baron Rothschild of England who determined them as the hen flea, *Ceratophyllus gallinæ*.

President W. D. Hunter: If there is no further business, adjournment will be in order.

Adjournment.

Afternoon session, Thursday, January 2, 1.30 p. m.

President W. D. Hunter: The first paper on the program will be presented by Mr. H. J. Quayle on, "Some Natural Enemies of Red Spiders."

SOME NATURAL ENEMIES OF SPIDERS AND MITES

By H. J. Quayle

Red spiders and mites, exposed as they usually are throughout their lives on the surface of the leaves or fruit, and not being very active, are subject to the attacks of a considerable number of enemies. Those that I will consider in this paper were observed to feed upon the spiders and mites of citrus trees in the citrus belt of southern California. The thing that seemed most striking in making these observations was the unusual variety of enemies, insects belonging to groups that we know best as not being predaceous. Thrips are certainly better known as plant enemies rather than as predaceous insects. Likewise members of the family Itonididæ (Cecidomyidæ) are better known on account of their gall-making habits and attacks on living plants, rather than as parasites. Staphylinid beetles are most familiar as feeders on decaying vegetable and animal matter, while a much smaller number are known to be predaceous. All members of the family Coniopterygidæ are predatory, but their habits are so little known that they are no less interesting than the others. In addition to these there are the usual Coccinelids, Hemerobiids, Chrysopids, a predaceous bug (*Thriphleps insidiosus*), mites and also a secondary Hymenopterous parasite, a chalcid.

The enemies of spiders as thus far investigated in a little corner of the extreme southwestern part of the United States, and only a beginning has been made, include, aside from several species of Acarina, representatives of six insect orders, the Neuroptera, Thysanoptera, Hemiptera, Coleoptera, Diptera and Hymenoptera. I will consider a few of these that are least known.

Conventzia hageni Bks. This Coniopterygid is one of the commonest enemies of spiders in the southern California citrus section. It feeds on the spiders both in the larval and adult stages.

The eggs are of a pinkish yellow color, oval in shape and are deposited singly on the under surface of the leaves. From six to eight days are required for them to hatch. The larva completes its development in from 18 to 22 days during which time, according to our observations, it molts three times. All stages of the spider are attacked, including eggs, young and adult. In attacking the eggs the mandibles

are thrust through the egg membrane and all of the contents consumed, usually from a single puncture. Ten or fifteen seconds is sufficient time for an egg to be devoured. The contents of the spiders themselves are similarly absorbed except that it requires a longer time, usually from 4 to 7 minutes. One larva devoured 96 spiders in 16 days, another a total of 226 spiders for its development from hatching to pupation, or an average of 15 per day; another 136 spiders in 11 days or 12 per day, and another 253 spiders for its entire larval period.

When mature the larva selects a place on the under side of the leaf, usually along the mid rib, for pupation. The cocoon consists of a double layer of silk, an inner compact layer more or less oval in shape and an outer flat, loosely woven web. Thirteen days are spent as a pupa, when the familiar grayish white "dusky wing," which is about 8 mm. long, emerges.

Oligota oviformis. This species of rove beetle (Staphylinidæ) occurs on citrus trees throughout the southern California section. The egg is of a light orange color and is laid singly on the under surface of the leaf. Hatching occurs in 7 to 9 days, and there appears a slender larva which when full grown is 2 or 3 mm. long. With its sharp pointed mandibles the larva punctures the spider about the center of the body, and by a pump-like action the body contents are sucked out. They, in the case of the common citrus spider, are of a red color and may be distinctly observed passing out of the body of the spider and into the alimentary canal of the more or less transparent larva of Oligota. As most of the body juices of the spider are absorbed they are spewed back again and the spider, which has been made transparent by the removal of the contents, resumes its normal red color and rigidity. This pumping back and forth is repeated two or three times before the mouth parts finally release the victim.

Records on the feeding of the larva of this beetle show that it will consume about twenty spiders each day. This too includes a majority of the more fully mature spiders, since they were transferred daily and consequently the eggs and smaller spiders would be left. Twelve to fifteen days represent the longest period we have been able to get the larva to live, and in spite of repeated efforts, it appears to die just before pupation. Counting the time that has actually been observed the larva of this insect will consume upwards of two hundred or three hundred spiders during its course of development.

The adult beetle does not eat so many spiders each day as the larva, but the longer life of the adult brings the total number consumed about equal. The adults eat on an average ten spiders a day and the maximum adult life determined was 32 days, making a total of over 300 spiders.

Scolothrips sexmaculatus Pergande. Our data on carnivorous thrips are fragamentry except for the species named which has been observed to feed on spiders and mites. This species has been repeatedly observed to feed on the citrus red spider and occurs most abundantly during the winter and early spring. Generally the eggs and younger spiders are eaten, but occasionally fully mature spiders are attacked. The time required to consume the contents of eggs and spiders varied from three to seven or eight minutes. Most of the contents of the egg were taken from a single puncture, then two or three additional punctures would be made on different sides and lower down, to get what little of the contents remained. In the case of the spiders themselves, after taking most of the body contents, the spider would be rolled around and punctured from different sides, the revolving being done by the fore legs of the thrips. The spiders were attacked mostly before the first or second molt and usually at a time when the spider was in a quiescent stage just preliminary to the molting process. All stages of the thrips, barring the pupa, have been noted to feed on the spiders.

Stethorus picipes Csy. This is the commonest species of the Coccinellidæ that was found to feed on the red spider, in fact, the only one of any consequence.

Feeding records on the larva of this beetle showed that in the case of one that lived 20 days it consumed a total of 189 spiders or an average of 6 or 7 per day. Another devoured a total of 110 spiders in 13 days of 8+ per day.

Arthrocnodax occidentalis Felt. This is a species of Itonididæ, the larva of which has been found to feed on the red spider. It has been observed to feed on *Tetranychus mytilaspidis*, *T. bimaculatus* and *T. sexmaculatus*, being most abundant on the last species, probably because they live in definite colonies and food is obtained with less moving about. Where the number of these Dipterous larvæ is large their effect on checking the spider is considerable. One on which records were kept consumed 165 spiders during a period of 15 days, or 11 per day, and another had 380 spiders to its credit in a period of 17 days or 12 per day. This species was sent to Doctor Felt for identification, who stated that it was a new species and it has since been described in a recent number of the JOURNAL of this Association.

Of the other better known enemies of spiders I will mention briefly but one, one of the Brown lace wings, *Hemerobius californicus* which is very voracious and eats a large number of spiders during its development. Records show that one of these larvæ ate 532 spiders in 17 days, 31 per day and another a total of 897 spiders in 20 days or an average of 44 per day when it died, from overeating or otherwise, though this one was no doubt mature and ready for pupation.

The effect of all these enemies in checking the spiders is difficult to determine. No doubt they aid considerably for each individual has a good many spiders to its credit, but the individuals are not numerous enough and the spiders often appear in large numbers nearly every spring in some sections of the southern California citrus belt.

President W. D Hunter: We will now listen to a paper by Dr. L. O. Howard, on "Economic Entomology at the Second International Congress of Entomology."

ECONOMIC ENTOMOLOGY AT THE SECOND INTERNATIONAL CONGRESS OF ENTOMOLOGY

By Dr. L. O. Howard

(Abstract)

The speaker called attention to the fact that it is only a few years since workers in economic entomology were rather looked down upon by systematists; especially, was this feeling indicated during his visits to the great museums of Europe ten years or more ago. There has, however, been a decided change in this attitude on the part of entomologists of Europe and of other portions of the world; and he spoke of the recent Congress at Oxford as exhibiting in a very recent and concrete shape the radical difference in sentiment which exists today as compared with that of ten years ago. While the program of the section on economic entomology was not especially strong, yet the sessions of that section were attended by larger numbers than those of any other section, and this attendance comprised not only the general public but very many workers in the aspects of pure science. The hall was filled at almost every session.

The speaker said that this increase in interest and this change in the attitude of other workers are natural enough on account of the remarkable discoveries which have been made during the past ten years and the vital interest which attaches to many of the recent discoveries in economic entomology, but he felt sure that the main reason for the change had been the absolutely sound scientific work which has been done by economic workers, and he placed the influence of the Association of Economic Entomologists at the head of the controlling influences. The change has been largely due to the work of this association and to the sound papers which have been published by its members.

President W. D Hunter: This paper is before the Association for discussion. I believe that the reason for the absence of discussion

on this report is because of its finality and completeness. The next paper will be presented by Mr. Britton.

MOSQUITO CONTROL WORK IN CONNECTICUT IN 1912

By W. E. Britton, *State Entomologist, New Haven, Conn.*

The past year has seen an awakening along the shore region of Connecticut regarding mosquito control. A good beginning has also been made in draining marsh areas. The work herein described has all been done by community effort and the funds expended have been raised wholly by voluntary contributions. Notwithstanding the fact that the whole shore region of Connecticut was examined by my assistants in 1904 and maps and recommendations furnished each town, almost no local action resulted, and it was not until 1911 that the people at Shippan Point, Stamford, raised money and drained about seven miles of coast marsh. In 1912 the idea spread like contagion. Darien and South Norwalk did likewise. Later Fairfield fell into line. In the city of New Haven the subject was agitated the latter part of the winter. An anti-mosquito committee was appointed by the Civic Federation: other organizations were asked to coöperate, and the work was organized under this committee. The entire city was divided into sections and a house to house canvass made. The week ending April 27 was known and advertised as "mosquito week" or "donation week" and was a definite time set aside for raising funds to finance the work of controlling the mosquito nuisance. Not only individuals, but men's clubs in churches, civic and improvement organizations, and business men's associations all worked together toward the end in view.

Many lectures and informal talks illustrated by lantern slides, charts and specimens were given by the State Entomologist or his assistant or some member of the committee. Notwithstanding the effort made we were somewhat disappointed that the total amount raised did not exceed $5,000. The amount needed was $25,000. This money was all expended for draining and oiling around New Haven, beginning with the most important breeding places. The superintendent of parks oiled the principal breeding places in the public parks but otherwise no municipal funds were available for the object of the campaign.

The largest area drained was at Morris Cove and South End east of the harbor. This had been a notorious breeding place for years. Certain small areas were also drained in the West River marsh. The results were satisfactory as far as the work was carried, but much more draining needs to be done.

As far as we can learn little or no salt marsh draining was actually done east of New Haven in 1912, though several communities took up the matter and progressed as far as having their respective territories examined and obtaining estimates. Draining will be done next summer in at least a portion of these communities.

The amount and cost of the draining work is shown in the following table:

MOSQUITO DRAINING IN CONNECTICUT

Location	Approximate Acreage	Cost
Stamford	200	$2,800.00
Darien	300	3,800 00
South Norwalk	600	7,500.00
Fairfield	1,250	8,400.00
New Haven	347	3,567.00
	2,697	$26,067.00

This money was raised entirely by voluntary contributions and the draining contracts were all executed by one firm. The average cost per acre of draining salt marshes is somewhat less than appears from these figures as in a number of cases small inland areas were included and some of the work was done on a footage rate. Nevertheless it falls a little below $10 per acre.

Early in the New Haven campaign the committee planned to oil such breeding places as could not be abolished by draining with the limited time and funds at its disposal. Oiling therefore was practiced on many fresh water pools and also on the salt marsh. The results of the work show that even salt marsh mosquitoes may be controlled by oiling, but I shall not recommend that method. Early in the season it is quite simple and inexpensive but in July, August and September, when breeding is at its height and the grass is tall and flooded at the roots, it is well-nigh impossible to cover the water with oil. Moreover, it should be applied only on the subsidence of the high tides and then not until it appears that the adults may emerge before the pools become dry. Otherwise much money is wasted. From expense accounts it appears that the average expense of oiling for the whole season amounted to nearly $3 per acre or about one third the cost of draining the same area. Drains will last for many years if given slight attention each season to keep them from being clogged by floating debris. The oil kills only the wrigglers in the water at the time and disappears before the next high tide. Kerosene and light fuel oil known as "34° distillate" were used. The latter though somewhat cheaper in lots

of several barrels, is more injurious to vegetation and to the various forms of animal life in the water—some of which destroy wrigglers. Kerosene, on the other hand, does not need to be ordered in advance, and may be obtained at every corner grocery. At first the oil was applied in small compressed air "Auto-Spray" outfits, but later in the season as the breeding became more extensive and more intensive, much more oil was used and larger pumps were needed. The "Double Forester" designed for fighting forest fires and made by W. & B. Douglas, Middletown, Conn., is excellent for this purpose. The Hardie Wheel outfit and several barrel spray pumps were given a trial, but these were difficult to transport across the marsh.

As a result of this crusade it was unusual in late summer to find *Culex sollicitans* around the outskirts of New Haven, where in 1911, this species composed about 90 per cent of the mosquitoes observed in the writer's own garden and on the grounds of the Experiment Station.

There is much more work to be done around New Haven and all along the Connecticut coast. Connecticut has a salt marsh area of over 22,000 acres. The elimination of the salt marsh mosquitoes, besides benefiting the public health, would mean thousands of dollars gain to the shore resorts, summer hotels and transportation companies. All property values would rise. The marsh itself through drainage would yield a profitable crop.

It is too large a problem for communities to solve separately. The movement should be state-wide. State authority to drain land will be asked of the next legislature and a state appropriation will be sought because the work will benefit the whole state. To this end the various organizations have united in preparing a bill to be introduced into the next legislature, and will support it at the hearings before the legislative committees.

President W. D. Hunter: This paper is now before the Association for discussion.

Mr. T. J. Headlee: I have been very much interested in this paper, and in view of the fact that many of the entomologists are unfamiliar with the extent of the work accomplished against the mosquitoes in the State of New Jersey by the late Dr. John B. Smith, I am tempted to give a brief account of some of the results he achieved. In 1901 Dr. Smith systematically started the work in New Jersey, and in 1904 published a report setting forth the results of his investigations. In this report it was shown that in addition to the local breeding species of mosquitoes found more or less generally all over the country, the New Jersey problem was complicated by the breeding

of untold millions of salt marsh forms, which while they bred exclusively on the salt marsh migrated from 30 to 40 miles inland. No matter how earnestly a municipality in the zone covered by these salt marsh species might endeavor to rid itself of mosquitoes, the good results of the prevention of the local breeding were always likely to be obscured by the influx of salt marsh broods. In the year 1906, the legislature passed a bill carrying an appropriation of $350,000 to be expended in the control of the salt marsh mosquitoes. Operating under this law about one fourth of the 200,000 acres of salt marsh have been drained, and the prevention of salt marsh mosquito breeding made in these areas merely a matter of keeping the drainage systems in operation. This drainage has covered the salt marsh along the coast from Secaucus on the north to a point some distance below Barnegat. Approximately $115,000 have been expended in this drainage. It is probable that already several millions have been added to the rateables of the state through this work of drainage, and the completion of the work cannot fail to increase the rateables of the state by less than twenty-one or twenty-two million dollars. This drainage, the investigation which preceded it, the convincing of the people of New Jersey that the drainage would control the salt marsh species of mosquitoes, and that it should be taken up without further delay, was the work of Dr. John B. Smith. When the salt marsh is all drained and the salt marsh mosquitoes eliminated from consideration, there still remains the problem of controlling the local breeding species. To meet this condition, the New Jersey legislature of 1912 passed a County Mosquito Extermination Commission law under which every county can have its local mosquito extermination commission and provide its own funds for the cleaning up of its own mosquitoes. Two counties in New Jersey have taken advantage of this law already and have produced results of such a nature as to encourage the other counties of the state.

Dr. L. O Howard: I should like to ask Mr. Quayle what is now being done in California.

Mr. H. J. Quayle: The work in 1904–5 was successful, but the following year the earthquake destroyed parts of the levee and it has gradually become weaker each year since. The people of that section are now, however, beginning the construction of a permanent levee and are attempting to make the area within permanently safe by ditching. The construction was just begun when I left California.

President W. D. Hunter: This is the only paper on mosquitoes. Is there any further discussion?

Mr. C. F. Hodge: I have nothing new to report on the mosquito work except that we have done away with screen windows and

doors, and have not even put the screens on our out-door sleeping porch the past summer. This is the result of quite a long anti-mosquito campaign in Worcester, Mass. It was begun by my class in biology making a mosquito survey of the city in 1902, then the schools, some of them, took up the matter; the pupils attending to stagnant water about their own homes and also draining and oiling pools in different sections of the city. This all went to form the basis of more thorough and permanent action. The Blackstone River was walled and all swampy places along its course filled. Beaver Brook has been laid in a cement channel and the low places are now being filled in this district, so that now a little oil on the few remaining pools gives us practical freedom from mosquitoes, which had formerly made certain parts of the city almost uninhabitable. Malaria, which had been gaining ground rapidly is now almost, if not quite, banished from Worcester. The last thing that remains is to find some effective treatment for catch basins in sewers. This is the "last ditch" for *C. pipiens* and, at times, is a very serious problem. There ought to be some kind of float invented for the outflow pipe which will make the use of surface oiling effective in the catch-basins of cities.

President W. D. Hunter: If there is no further discussion, we will have Prof. Cooley read his paper on "Notes on the Habits of the Spotted Fever Tick."

NOTES ON LITTLE KNOWN HABITS OF THE ROCKY MOUNTAIN SPOTTED FEVER TICK (DERMACENTOR VENUSTUS BANKS)

By R. A. Cooley, *Montana Agricultural College*

It is well known that most ticks in all of the active stages of their development ascend grass, small bushes or other supports in order that they may catch hold of passing animals. This adaptation is a very necessary one in view of the fact that their only chance of securing a host is by waiting for one to pass within reach.

In connection with the investigations of the Rocky Mountain Spotted fever tick (*Dermacentor venustus* Banks) in the Bitter Root Valley, Montana, in coöperation with the Bureau of Entomology, interesting observations have been made on the waiting habit of this species. In numerous instances in nature and in out-of-door conditions, which very closely resemble nature, adults of this tick have been found in a definite "waiting attitude" which we regard as habitual. A dead, bare, upright twig, or grass stem, is usually selected

and, with the capitulum directed downward, the support is firmly grasped with the third pair of legs, these legs serving as the only means of attachment while the first, second and fourth pairs are extended and waved in reaching for animals which approach.

In arranging to have made a drawing of ticks in this attitude, eleven individuals, including both sexes, were placed in a very large lamp globe pressed into a box of soil and covered by a piece of gauze. Small, bare sticks and grass stems were erected in the soil. Several days passed during which the ticks crawled about the cage without apparent purpose and then, one by one, a part of both sexes came to rest and assumed the "waiting attitude."

It was soon observed that when left undisturbed the legs were all slowly brought down in contact with the support, but when the hand was passed between them and the nearest window, five feet away, all the legs, excepting the third pair, were instantly extended and slightly waved as though reaching for a host. The cage was left in the same place, out of the direct sunshine, for about nine weeks and during that period the test was repeated very many times by several persons. It was further noticed that the ticks showed a distinct preference for the side of the twigs toward the window, which brought the dorsal surface and the eyes toward the strongest light. It seems clear, therefore, that stimulation is received through the eyes and probable that this tick becomes aware of the approach of animals by the occurrence of shadows or by cutting off light.

In one instance, while the cage was temporarily in the sunshine, we were able to "lead" a tick across the smooth ground in the bottom of the cage by suddenly casting the shadow of a pencil upon it through the glass wall. The tick immediately changed the direction of its movement and walked rapidly under the shadow toward the pencil, avoiding the sunlight at the sides. It is well understood, and we have demonstrated, that ticks avoid direct sunlight and it is possible that this tick was seeking protection from the sun, but it is equally possible that this observation indicates another adaptation for securing a host, for it is clear that in nature a suddenly appearing shadow means the approach of an animal and that by following under the shadow toward the sun the tick will arrive at the feet of the host. We have been told by persons in Montana that after sitting on the ground for a short time they have seen ticks crawling toward them on the ground.

Blowing the breath through the top of the cage always caused the ticks to quickly extend the legs the same as when the light was cut off. Suddenly blowing the hot breath into the cage sometimes caused them to drop quickly to the ground. It seems to be indicated that

the ticks may be informed of the presence of a host by feeling its breath and that they may avoid being taken into the mouth with the food of animals, by dropping when a hot breath is felt. In a few instances this tick has been seen waiting on green grass in our large open-air cages, but this is exceptional and dead stems are distinctly preferred by the adults. If the selection of dead rather than living vegetation as supports is a fixed habit, it doubtless serves as a protection against being destroyed in the mouths of animals.

Repeated attempts were made at stimulation by the heat or odor of the hand applied at the top of the cage about five inches away from the ticks but without success.

President W. D. Hunter: We are now ready for the discussion on this paper.

Mr. E. C. Cotton: I would like to ask Mr. Cooley if he ever has detected any indication of a sense of smell by this tick.

Mr. R. A. Cooley: I have not detected any evidence of the sense of smell in this tick. We had this sense in mind when we tried to stimulate the individuals in the cage by placing the hand close to the top, thinking that the heat or odor might arouse them. The results were negative.

President W. D. Hunter: Professor Cooley's work reminds us that remarkable progress has been made in the study of the adaptations of ticks. In fact, our knowledge of adaptations in this group is rapidly becoming more complete than among insects proper. Heretofore the contributions that have been made have dealt largely with structural adaptations but Professor Cooley's contribution deals with one of a physiological character. These extreme adaptations are not surprising in view of the inability of the tick to move about and its necessity for waiting until a suitable host appears. The longevity of one stage of the spotted fever tick has been determined to be over six hundred days. Evidently the physiological adaptation to which Professor Cooley has called attention is an effort on the part of the organism to reduce this long period of waiting by extreme activity in the presence of a possible host.

A Member: Will the cattle tick when it climbs up spears of grass show similar habits?

Mr. E. C. Cotton: In the case of the cattle tick we have a different situation for here it is the seed tick stage we find on grass instead of the unengorged adult. The seed ticks occur in large clusters, as many as 2,500 in a bunch instead of singly as with the unengorged adult of the spotted fever tick, therefore it is more difficult to observe indi-

vidual movements, but they do wave the first pair of legs when disturbed. If a host comes within reach they are able to get on.

Mr. Brain: In connection with this point I might mention that in the case of *Argas persicus* Oken, the sense of smell seems to be depended upon almost entirely in finding a host. Temperature probably plays a slight part too, but I found by experiment that if the first pair of legs are amputated the ticks live quite well for a time, but apparently die later of starvation. A number of such ticks were placed, together with normal specimens, in a box containing a chicken. Next morning it was found that 27 out of 30 of the normal ticks had fed while only 1 out of 30 of the specimens without the front pair of legs was engorged.

President W. D. Hunter: In that case are the legs not used for grasping?

Mr. Brain: I think not. The ticks use them most for touch. The front pair are not used for grasping.

Mr. E. C. Cotton: In regard to Mr. Hunter's question I think that Dr. Nuttall, of the University of Cambridge, has demonstrated very nicely that ticks are dependent upon the Haller's organ for the location of their host. This organ which is olfactory in function, and the only sense organ that has been clearly demonstrated in ticks, is situated on the last tarsal segment of the first pair of legs. With ticks of four different species, which in nature feed only upon blood, he was able, by amputating this segment, thus removing the sense of smell, to induce them to engorge on various liquids some of which caused the death of the tick.

President W. D. Hunter: If there is no further discussion we will proceed to the next paper by Mr. S. J. Hunter, on "Pellagra and the Sand-fly."

PELLAGRA AND THE SAND-FLY, II

By S. J. Hunter, *University of Kansas, Lawrence, Kans.*

At the Washington meeting last year an account of this work up to that time was given, in which 1,282 live sand-flies were used in an endeavor to produce experimentally Pellagra in guinea pigs and monkeys. The work was resumed at the opening of spring this season and covered three lines of investigations.[1]

[1] As last year this work has been carried on with the assistance of Mr. W. T. Emery, one of my graduate students and the pathologic side has been conducted in conjunction with Dean Crumbine and the School of Medicine.

1. The survey on the distribution of sand-flies in Kansas.

2. A detailed investigation into their life habits and conditions under which they exist.

3. Continuation of the inoculation experiments.

Since these investigations when completed will be published in full it is not the purpose of this paper to occupy your time now with details, but rather to give in briefest possible form a summary of the work thus far, under the above heads.

I—Distributon: The only species thus far found to be generally distributed over the state is *Simulium vittatum*. The survey thus far seems to show that the immature forms of this species may be found where ever there is trickling water, throughout the summer months. I use the word *trickling* in order to include waters which flow from running springs, in little rivulets through the grass. Here attached to the blades of such grass *Simulium* larvæ sometimes abound.

II—Life History: This species is not confined to clear or pure water. A short distance below where the septic tank of a city of the second class empties into the Neosho, larvæ and pupæ were abundant this season.

In an examination of the riffles for a considerable distance along the bed of a small creek, the only place these larvæ were found was in the riffles running through a hog lot. There the hogs were wallowing and polluting the waters in and above the riffles.

They are not confined to the rural districts but are found in Turkey Creek which runs through a populous part of Kansas City. Last season they were more abundant here than elsewhere.

The females prefer to oviposit in the evening and place their eggs on wet leaves in shallow ripples or on rocks in the same position. They usually place the tip of the abdomen in the water where the water comes up on the rocks in a thin film on the down side of the stream. As the fly oviposits she moves along, stringing the eggs, but holding on to the rock above the water while the tip of the wings and abdomen are vibrating in the water. This process occupies in all about ten minutes and about 200 eggs are usually deposited.

When first deposited the eggs are whitish or creamy in color, turning yellowish, then brownish and almost black at the time of hatching.

When first hatched the larvæ are almost invisible with an ordinary 12x lens.

The duration of the egg stage depends somewhat upon the temperature of the surrounding water, though usually lasting about a week.

The length of the larval stage depends upon the temperature of the water and upon its rapidity. It varies from three or four weeks

under good conditions to several months, as this is the overwintering stage.

The duration of the pupal stage varies but is usually two to three weeks.

The length of the adult's life is not definitely known though the flies have been observed to live several days. Those which have fed on human blood exist for a longer period than those which have not. Such have existed eight days before being used. There are two principal broods, one in July and one in October, though some are found emerging throughout the entire season.

As far as our observations go, based on the work of the fly and the anatomy of its mouth-parts these flies do not pierce but rather scrape until the blood oozes through the denuded spot. At certain times they bite the human skin readily. A second fly has been observed to participate in lapping up the superabundance of blood caused by the scraping of the first fly.

III—Experiments: Last season the flies were very abundant. This season they were notably rare, due principally to the flooded condition of the creeks in the northern part of the state and to the continued drouth in the southern part of the state.

Turkey Creek in the southern part of the state where our breeding experiments were so successful last year was entirely dry this season and the rocks covered with quantities of dried pupæ and larvæ.

It was not possible, therefore, to conduct as many inoculation experiments as last year, due to the absence of flies and likewise to the absence of incipient cases of Pellagra.

Last year we had an abundance of flies and nine cases of Pellagra. This year we had few flies and only two new cases of Pellagra.

Six monkeys were imported direct from India for this work. The almost total absence of flies in July as well as the want of a Pellagrin in the proper stage prevented any successful inoculations then. In the fall brood two inoculations have been made without waiting for the flies to bite the monkey after having bitten the Pellagrin but introducing them by maceration attended by the proper aseptic precautions.

The last inoculation, thus far, was made on a second monkey on the dates of December 16, 17 and 20, using flies that had emerged on the 12th and had bitten the Pellagrin on the 14th.

Obviously sufficient time has not elapsed for the results of these experiments to become apparent.

Summing up the work of the past two years, for and against the Sambon theory:—

1. The number of sand-flies has been directly proportional to the number of cases of Pellagra.

2. The first appearance of the cases of Pellagra is coincident with the principal broods.

3. Just succeeding the time of the principal broods the flies appear to bite more vigorously.

4. Sand-flies which have fed on human blood live several days longer than those which have not been so nourished, thus favoring an incubation period for a parasite if such there be.

5. Pellagra, thus far in Kansas, has appeared almost entirely in one restricted locality. Of the nine cases recorded last year five were traced back to one town. In this region flies are widely distributed and unusually abundant.

Upon the other hand,

1. Pellagra has never been produced in any other animal experimentally either through inoculation or through transference by means of sand-flies.

As far as our history of this subject goes the appearance of Pellagra in Kansas is a recent occurrence. Nearly all of the cases are those of natives that have never been out of the state.

From this it would seem that the etiology of Pellagra exists in Kansas.

The situation here is not complicated through long standing conditions. It is the purpose, therefore, to continue this phase of the work and with it the correlation of the clinical and pathological phases by the medical school of the University of Kansas.

Mr. S. J. Hunter: To illustrate one point: we took this problem up two years ago and reported Douglas County, the county in which the University of Kansas is located, as being absolutely free from Sand-fly, and last June I stepped across a stream in the grass which ran about five gallons an hour as an overflow of one of the campus drinking fountains, and found the larvæ there on the blades of the grass in great numbers. That is, it requires an unusual scrutiny of conditions in any given locality before a conclusion can be safely drawn regarding the presence or absence of the Sand-fly.

President W. D. Hunter: The reader spoke advisedly when he referred to the Sambon theory. It is surprising that Doctor Sambon has performed no experiments whatever. He has merely drawn conclusions. The work of Mr. Hunter is much more suggestive as regards the demonstration of the possible transmission of pellagra by Sand-flies than anything that has been done and allows the suggestion that if the Sambon theory is ever proven it is likely that some other investigator will accomplish it. The investigation in South Carolina, which

the Bureau of Entomology has been conducting in coöperation with the Thompson-McFadden Commission of the New York Postgraduate School of Medicine, has failed to reveal any circumstance that tends to connect Simulium with pellagra transmission. In this work, by means of special facilities provided, an extremely exhaustive investigation of pellagra in a rather restricted locality was conducted. A house to house canvass was carried out and complete accounts of the histories and surroundings of cases were compiled Simulium is present, but not in sufficient numbers and not in the exact places where it would appear possible that they were connected with the disease.

Mr. S. J. Hunter: We talked that over quite fully, Dr. Siler of the Army Medical Corps and I, and both of us spoke of the fact that it was remarkable that a purely geographical theory should receive so much attention. Dr. Siler explains it on the grounds that Sambon seems to be a good prognosticator. For example, Dr. Siler spoke of visiting peasant huts with Dr. Sambon, where cattle and people lived under the same roof. Here the stable fly was feeding on both the cattle and peasant. Dr. Sambon remarked to Dr. Siler that there would in all probability be an outbreak of Anthrax here soon. And such an outbreak did shortly occur. One of Sambon's deductions, if frequently corroborated, must certainly be considered as important in its relation to his theory. That is, parents and children may all be pellagrins, living in a Sand-fly zone but when the family moves out of the Sand-fly zone subsequent offspring are free from Pellagra.

Mr. W. A. Riley: I should like to inquire whether there are any further data relative to the susceptibility to pellagra of the monkeys which are being experimented upon. It is well-known that the typical insect-borne diseases may be transmitted from animal to animal by transfusion of blood as well as by the insect host. This is true of malaria, yellow fever, Texas fever of cattle, and various trypanosome and other diseases. As I recall the report of last year, there was no evidence that the monkeys were affected by transfusion of blood from a pellagrin.

S. J. Hunter: That is a question we discussed last year. The monkey has been tried in every shape and form. Transfusions of living blood, inoculation of various organs and tissues taken from recently deceased subjects gave negative results. In this particular, Infantile Paralysis differs in that it was produced experimentally before being carried through the agency of the stable fly.

Mr. W. A. Riley: In view of the known difficulty in carrying on experiments regarding the insect transmission of disease, would it not be important to first determine the suceptibility of the animals experimented upon. If the animals are not susceptible of course

experiments with them to determine whether Simulium transmits pellagra would be futile.

Mr. S. J. Hunter: I may say that the results of the experiments in the laboratory failed to prove that the monkey was susceptible.

President W. D. Hunter: Is there any further discussion? If not, the next paper is by Mr. C. T. Brues on "The Transmission of Infantile Paralysis by *Stomoxys calcitrans*."

THE RELATION OF THE STABLE FLY (STOMOXYS CALCITRANS) TO THE TRANSMISSION OF INFANTILE PARALYSIS[1]

A Résumé of Observations by Brues and Sheppard and of Experiments by Rosenau and Brues

By Charles T. Brues

Infantile paralysis, more accurately designated anterior poliomyelitis or acute epidemic poliomyelitis, is a disease which has aroused much interest in the United States for a number of years on account of its serious nature and much increased prevalence. Complete ignorance as to the way in which it spreads and develops in epidemic form has also served to augment the dread of this disease. It affords me great satisfaction, therefore, to be able to present today a résumé of some observations and experiments bearing on the probable method of transmission of infantile paralysis.

These entomological investigations were conducted under the auspices of the Massachusetts State Board of Health and have extended over a period of two years. The State Board had previously conducted extensive investigations along various lines under the guidance of an advisory committee consisting of Drs. R. W. Lovett, M. W. Richardson, M. J. Rosenau, Theobald Smith, J. H. Wright and J. L. Morse, and Doctor Richardson later gave much of his time to further the success of the entomological work. During the summer of 1911 an extended series of entomological field observations was made by the writer in association with Dr. P. A. E. Sheppard who was studying the epidemiology of the disease for the State Board of Health. The more important facts then ascertained have already been published in the Journal of Economic Entomology[2]

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 62.

[2] Brues, C. T. and Sheppard, P. A. E. The Possible Etiological Relation of Certain Biting Insects to the Spread of Infantile Paralysis. Journ. Econ. Entom. Vol. 5, No. 4, pp. 305–324 (1912), previously briefly abstracted in the Monthly Bulletin of the Mass. State Board of Health for December 1911, pp. 337–340.

together with the hypothesis based on these observations, that *Stomoxys calcitrans* might be responsible for the spread of poliomyelitis, aided possibly by other blood-sucking flies. During the summer of 1912 an attempt was made by Prof. M. J. Rosenau of the Harvard Medical School and the writer to transmit the disease experimentally through the agency of *Stomoxys*, using monkeys for this purpose, as these animals are susceptible to poliomyelitis. The successful outcome of this work was announced in September, 1912,[1] and was soon afterwards confirmed by Doctors Anderson and Frost of the Public Health and Marine-Hospital Service, who repeated the same experiments with similarly positive results.[2]

Infantile paralysis was first recognized as a distinct disease in 1840 by Heine, a German surgeon who found that the spinal cord was the site of attack. Many years later, Strümpel in 1848, suggested that the lesions in the cord were caused by an infectious agent, and in 1890 Medin published the first good clinical account of poliomyelitis. Within the last ten years, Wickman in Sweden and various others, both in Europe and America, have investigated the disease with great care, so that its clinical, epidemiological and pathological aspects are well known.

The living organism which causes the lesions in the spinal cord is not known, but it has been demonstrated to be an ultravisible virus which passes through a Berkefeld filter only with difficulty, suggesting that it is just beyond the range of visibility.[3] Its pathogenic activities are mainly restricted to the anterior portions of the spinal cord where the motor nerves take their origin, and the resulting degeneration of these motor nerves produces a more or less complete paralysis of the corresponding muscular elements. The arms and legs are most frequently affected, although paralysis of many other muscles is common in varied combinations, sometimes bilateral or unilateral, but often irregular in distribution. In fatal cases, death usually results from a paralysis of the respiratory muscles and consequent asphyxiation. The actual mortality is rather low, averaging from 12 to 17 per cent, when only typical, paralytic cases are considered. In

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[1] Rosenau, M. J. and Brues, C. T. Some Experimental Observations upon Monkeys Concerning the Transmission of Poliomyelitis through the Agency of *Stomoxys calcitrans*. Bull. Mass. State Board Health, Sept. 1912, pp. 314–317.

[2] Anderson, J. F. and Frost, W. H. Transmission of Poliomyelitis by Means of the Stable fly, *Stomoxys calcitrans*. Public Health Reports, Vol. 27, No. 43, pp. 1733–1735. (October 1912.)

[3] Since this article was written, Flexner and Noguchi (Journ. Amer. Med. Assoc., February 1, 1913) have obtained in cultures, extremely minute bodies of variable size and appearance which they believe may be the causative organism. This, however, is still somewhat in doubt.

addition there are undoubtedly many mild, atypical or abortive cases which are difficult of diagnosis. Of the remaining 83–88 per cent, about 25 per cent, recover entirely, some very quickly and a few others only after a number of months, while about 60 per cent remain permanently crippled in varying degrees. Children under six years of age are most commonly affected, approximately two thirds of the cases falling into this period. Adult cases are far less frequent, but here the mortality is correspondingly higher, and there is less likelihood of regained muscular control in non-fatal cases. Poliomyelitis is difficult to recognize in its earlier stages, for the preparalytic functional disturbances are not ordinarily at all commensurate with the grave nature of the disease. Prognosis is equally difficult, owing to the subsequent very erratic course of the infection.

On account of its greater prevalence in the Scandinavian peninsula and in Germany, it has been suggested that poliomyelitis was introduced into America from one of these European countries. However this may be, during the last seven or eight years our own country has suffered more than any other, although the increased prevalence of the disease here has been paralleled in parts of Europe, and outbreaks have occurred in the West Indies, in Australia, and in other parts of the world. For several years prior to our entomological work, there had been a growing suspicion among those familiar with the disease, that poliomyelitis like several other epidemic diseases, might be insect-borne. Since no data had been collected with this possibility directly in mind, it was necessary to determine a number of points by means of the direct observation of a large series of cases, before it was possible definitely to suspect any particular insect as a probable carrier. However, from previously made studies on the epidemiology of the disease, it appeared that many facts suggested some relation between insects and poliomyelitis.

Cases usually appear sporadically and very frequently in such a way as to render it very difficult to explain their origin on the basis of infection by personal contact. They also show a seasonal distribution very different from what might be expected of a contact infection. In winter the disease almost disappears, at the time when children are in closest association both in schools and elsewhere, but rapidly increases in prevalence during the summer, in late June and July, to a maximum in August, then rapidly decreases in September and October to the very slight winter incidence. Geographically, again, poliomyelitis does not follow the lines of densest population, but is on the contrary, quite generally typical of rural, or at least semi-rural districts. Thus in Massachusetts, in 1909, of the cities and towns where the disease occurred, the twenty-five most affected

showed an incidence ranging from 5.26 to 1.12 per thousand (averaging 1.94), the average population of these places being 3,294; the twenty-five least affected showed an incidence of from .15 to .012 per thousand, (averaging .098) and had an average population of 32,217. Complete data concerning many other regions are difficult to collocate, but the greater rural incidence seems to be an established fact. The significance of this distribution becomes very great when we consider the fact that both domestic animals and the majority of insect species are most abundant over the same areas where poliomyelitis appears in its most extensive outbreaks.

With these, and other considerations of minor importance in mind, it became possible to draw some tentative conclusions which might be strengthened or disposed of by the actual examination of the environment of a series of cases.

As a matter of fact, members of nearly all groups of insects which by their life-history seem suited to play a part in the dissemination of disease, have been implicated either as specific or contaminative carriers of disease in man or the higher mammals. The seasonal distribution of poliomyelitis makes it evident at once that insects like fleas, which are known to carry plague; lice which transmit typhus fever; or bedbugs, which are suspected of distributing kala-azar fever, could hardly account for the high summer incidence and practical winter disappearance of poliomyelitis. They vary somewhat in abundance with the progression of the seasons, but are nevertheless quite prevalent all through the winter. Mosquito-borne diseases of course, show a very decided æstival periodicity, but at least in the case of yellow fever, malarial fever and dengue, spread very rapidly in epidemic form, involving a much greater percentage of the population of a community. This is quite to be expected, on account of the general abundance of mosquitoes and their great persistence in search for human blood. For this reason they enjoy great opportunities of infection in the presence of a case of one of these diseases, and exhibit a corresponding activity in distributing the organisms later among other persons. Thus, while poliomyelitis appears in truly epidemic form, it has never developed into extensive outbreaks, comparable with those of mosquito-borne diseases. There appeared, however, no very decided reason why some relatively rare mosquito might not be concerned, except that the summer abundance of poliomyelitis does not show any regular relation to rainfall or to general mosquito prevalence. Ticks are known to act as vectors for a number of diseases, but on account of their method of attachment to the skin of the host for considerable periods, are very noticeable, and in none of the cases visited could we demonstrate the occurrence of a tick bite, either by

examination or by questions relative to the history of the case before the onset of symptoms. Certain Reduviid bugs are know to carry a trypanosome disease of man known as barbiero fever in the American tropics, but as all of our native species of this family appear to inflict very painful bites, the failure to obtain histories of such bites, seemed to eliminate these bugs from any connection with poliomyelitis.

There remain various Diptera with blood-sucking habits, and some of these seemed to offer the most promising field for investigation. Many, however, for one reason or another fail to meet all necessary requirements. Gadflies, of the genus *Tabanus* have been sometimes especially noticeable in localities where epidemics of poliomyelitis have occurred, notably in maritime towns, but they are not so abundant in the inland rural communities. Their place is there taken by the related *Chrysops*, but these do not occur in the later part of summer, when the disease shows its greatest incidence. On account of their great thirst for blood, the small black flies of the genus *Simulium* have been suspected as carriers of a human disease known as pellagra. They are most abundant in the spring, at least in our region, and may thus be ruled out as possible vectors for the virus of poliomyelitis. The horn-fly, *Hœmatobia*, appears in abundance occasionally upon animals on farms, but was seen in the vicinity of only a small proportion of the cases visited.

In addition to the insects already mentioned, which might be expected to act as specific carriers, there are others, like the common house fly which may act as contaminative carriers for certain bacterial diseases. Such a method of spread is always supplementary to infection by contact, ingestion, etc., and as such channels of infection had not been demonstrated otherwise, it seemed very unlikely that the house fly should bear any relation to the transmission of poliomyelitis.

After thus considering the various possibilities, it appeared probable that the common blood-sucking stable fly, *Stomoxys calcitrans*, might be implicated. In fact, this seemed to be the only insect which could not be disregarded for one or more of the reasons set forth above. Briefly, the reasons for suspecting a relation between *Stomoxys* and poliomyelitis were the following:

1. The blood-sucking habits of the adult fly suit it for the transfer of virus present in the blood.

2. The seasonal abundance of the fly is very closely correlated with the incidence of the disease, rising rapidly during the summer, and reaching a maximum in July and August; then slowly declining in September and October.

3. The geographical distribution of the fly is, so far as can be ascertained, wider, or at least co-extensive with that of poliomyelitis.

4. Stomoxys is distinctly more abundant under rural conditions, than in cities and thickly populated areas.

5. While the disease spreads over districts quickly and in a rather erratic way, it often appears to follow along lines of travel, and it is known that Stomoxys flies will often follow horses for long distances along highways.

6. In a surprisingly large number of cases, it appeared probable that the children affected had been in the habit of frequenting places where Stomoxys is particularly abundant, *i.e.*, about stables, barnyards, etc.

During the summer of 1911, 88 cases of poliomyelitis were visited and studied both with regard to the individual histories of the patients and to the insect fauna of their environment. Stomoxys was found in every case, and often in exceptional abundance, while nothing appeared which would cast doubt upon a possible association of this insect with the disease.

The suspicion attaching to Stomoxys seemed to be strong enough to warrant direct experimentation, and during the past summer Prof. M. J. Rosenau of the Harvard Medical School and the present writer attempted to ascertain by experiments with monkeys whether the virus of poliomyelitis could actually be transferred by Stomoxys under controlled laboratory conditions. For this purpose a large cage was constructed of light wood, with a flat wooden base about four by five feet in size, with sides three feet in height. The sides and a part of the top were covered with ordinary screen wire, a strip one foot wide being left along one side of the top. The inner walls were further lined with surgeon's gauze to afford a resting place for the flies, and the open part of the top provided with a large black cloth which could be lifted to give access to the interior of the cage. Specimens of Stomoxys were collected daily in amounts of from 300 to 500 and admitted to the cage, so that in spite of the high mortality among the flies thus caged, a thousand or more were continually present. A healthy monkey was now infected with poliomyelitis by inoculation in the brain with a lethal dose of active virus of the disease. The virus in this case was obtained by making an emulsion of bits of spinal cord from monkeys which had died of the disease after being similarly infected; it had come originally from a human case of the disease, but had been later passed through a number of monkeys, as can be done without impairing its virulence. This monkey was then exposed to the captive flies daily, by stretching it at full length and rolling it in a piece of chicken wire, then placing it on the floor of the cage. Such treatment was necessary as the agile monkey would otherwise soon have demolished the frail cage. The Stomoxys fed on it freely during

this period, as well as later, after paralysis had set in. This usually appears on the fourth or fifth day, and death ensues several days later. Alternating with the inoculated monkey, healthy monkeys were similarly introduced into the cage at intervals. In this way new monkeys were inoculated to keep a supply of such infected animals and additional healthy ones were exposed to the flies, which fed willingly and in considerable numbers on each occasion. Thus the flies were given every opportunity to obtain infection from the monkeys, since the animals were bitten during practically every stage of the disease from the time of the inoculation of the virus till their death following the appearance of paralysis. By the same arrangement the healthy monkeys were likely to be bitten by flies that had previously fed during the various stages of the disease on the infected monkeys. The flies had meanwhile enjoyed the opportunity of incubating the virus for periods varying from the day or two which usually elapses between consecutive feedings, to the two- or three-week period for which at least some (although a very small percentage) of the flies lived in the cage.

At this point it should be mentioned that no fear was to be entertained that the healthy monkeys might become infected on account of their being introduced into the cage in which the poliomyelitic animals had been placed. Attempts to transfer the disease under conditions of far more intimate nature have been made, but have always given negative results.

In all, twelve apparently healthy monkeys of a small Javan species were exposed to the flies in the manner described for the infected monkeys. Some were placed in the cage only once or twice, and others a number of times after varying intervals. These exposures usually lasted for about half an hour, but were sometimes more protracted. No results were apparent until two or three weeks after the experiment was well under way, and then in rather rapid succession six of the animals developed symptoms of poliomyelitis. In three, the disease appeared in a virulent form, resulting in death, while the other three experienced transient tremblings, diarrhœa, partial paralysis and recovery. It is interesting to note that several of the monkeys had diarrhœa, wherein their affection resembled the human disease more closely than the type developed in monkeys after inoculation with virus in the brain, for gastro-intestinal upsets in children are frequently associated with infantile paralysis.

In support of the clinical appearance of the disease in the fly-bitten monkeys, microscopic examination of the spinal cord revealed the characteristic lesions of poliomyelitis, but we were unable to induce the disease in further monkeys by intracerebral inoculations with

emulsions from the cords of the dead monkeys. This is at present the most accurate method of diagnosing the disease.

Soon after these results were announced, however, Drs. J. F. Anderson and W. H. Frost of the Public Health Service repeated these experiments in the federal hygienic laboratory at Washington. They obtained the disease in healthy monkeys that had been bitten by Stomoxys which had previously fed on intracerebrally inoculated monkeys, and further succeeded in inducing the disease in another monkey by inoculation with emulsion of the spinal cord from one of those which had been infected by the flies.

It thus appears to have been satisfactorily demonstrated that Stomoxys can transmit infantile paralysis from one monkey to another. Whether this is the ordinary method of spread, remains yet to be definitely shown. It has already been stated, however, how well the seasonal occurrence, distribution and other facts connected with Stomoxys agree with the epidemiology of the disease.

Although many facts are well in accord with such a method of spread, the results of some investigators appear at first sight to be at variance with such a view, and these should be given careful consideration. It has been shown by a number of workers that the virus exists in the nasal mucosa. By most extensive observations, moreover, Kling, Pettersson and Wernstedt in Sweden have succeeded in many instances in producing poliomyelitis in monkeys by inoculating into the nervous system material washed from the mucous membranes of persons who had died of the disease, of those suffering from it, and of healthy persons in close contact with patients. This has led them to believe that the infection is ordinarily acquired through the mucous membranes, the virus being derived from this same site in those suffering from the disease. One important link is missing in this chain of evidence, however: it has never been shown that virus derived from the mucosa can produce poliomyelitis by implantation on the mucosa of healthy monkeys. We must, therefore, assume a fundamental difference in susceptibility between man and monkey, if these results are believed to have any significance in relation to the ordinary method of spread of poliomyelitis. Such a difference in susceptibility is improbable in view of the ease with which monkeys may be infected by other methods. A second objection lies in the fact that virus direct from the spinal cord can sometimes produce infection by implantation on the nasal mucosa, but as the virus from the mucosa cannot, so far as we know, and since, outside of the laboratory, virus from the cord never reaches the mucosa of a healthy individual, the bearing of these experiments on the possibility of natural transmission in this way must be regarded as not yet proven.

Flexner, Howard and Clark in this country, and others abroad have worked to some extent with insects of certain kinds to see whether these could retain the virus of poliomyelitis in a virulent condition in their bodies for any length of time. This has been done either by allowing the insects to feed on bits of infected spinal cord, or by allowing them to suck the blood of infected monkeys. After varying periods the insects were then ground up in a mortar and injected intracerebrally into monkeys. Positive results have been obtained in the case of house flies, bedbugs, and possibly with fleas, but only negative ones with several species of mosquitoes and lice. In all these cases, it must be remembered that the pulverized insects were injected into the brains of the monkeys, so that these results do not have a very direct bearing on the epidemiology of the disease.

The fact that Stomoxys does not bite children so very frequently suggests that perhaps poliomyelitis may possibly be regularly spread from some domestic animal which acts as a reservoir for the virus, and it has long been suspected that this disease in man may bear a relation to some paralytic disease of animals. On the other hand, the numerous mild cases which are usually regarded as abortive poliomyelitis may serve as reservoirs as well as the paralytic cases, and then the frequency with which Stomoxys bites might account for the incidence of the disease without any connections with animals. These are matters which will require much further study.

President W. D. Hunter: This paper is open for discussion.

Mr. C. L. Marlatt: I would like to ask a question, and that is, do I understand, from the diagram exhibited showing occurrence of the disease in the winter months (December, January, February, etc.), that the disease originated in these months, or are these cases carried over from the summer?

Mr. C. T. Brues: We have no evidence except that the winter development of the disease is rather more than might be expected from the rarity of the fly in the winter.

Mr. C. F. Hodge: We have been working on the habits of this insect and are surprised to find them in the winter in the stable biting animals.

Mr. Brain: I think Prof. Brues and his colleagues have made a very important advance in the subject of medical entomology by the discovery of the connection between *Stomoxys calcitrans* and Poliomyelitis, but I feel that a further step is necessary, and that is to ascertain how many bites of this fly are necessary for the transmission. In these experiments some 300 flies were used, but it is not known how many fed on any particular day, nor how many fed before infection.

In nature 300 bites are impossible as are 200, 100, or even 50. Twenty seem improbable to me, while any number up to 10 is quite possible. Stomoxys seems very fond of feeding around the ankles, and I have seen two feeding on a child who was so intent on something or other that he did not notice the flies at all. In the case of heart-water, a disease of sheep, goats and cattle, which resembles Poliomyelitis in many ways, it has been found that one can be reasonably sure of getting the disease from the bites of three infected ticks. If such could be shown to be the case with Stomoxys in Infantile Paralysis, I think it would be a very important addition to the knowledge of the subject.

Mr. C. T. Brues: Just a word in regard to the fact that it actually takes a large amount of blood to transfer the disease from one animal to another by inoculation in this way. I do not think that a large number of flies would be necessary to transfer it in this way, much less that a single bite would produce disease in a merely mechanical way. I very much doubt if any of these monkeys could have been bitten by many infected flies.

Mr. Brain: In connection with the inference that there is a cycle, part of which occurs in the body of the fly, from the fact that it requires a large amount of blood to cause the disease, it seems to me that I have heard of a similar case where a very small, or a very large amount of blood was necessary. I do not think the case is quite understood. That there is anything like a ten days' incubation period in the body of the fly seems to be disproved by the experiments of Anderson and Frost, for they inoculated the first monkey with the virus on October 3d, and the second on October 5th. Flies were fed a few hours after inoculation, and by October 13th they had two monkeys down from the inoculation and two from fly transmission.

Mr. E. P. Felt: We have with us Dr. C. F. Hodge of Clark University, Worcester, Mass., who has developed a very successful flytrap and I think it would be very interesting if we could hear from him at this time.

President W. D. Hunter: If there is no objection we will allow Dr. Hodge five minutes in which to discuss his flytrap.

A NEW FLY TRAP

By C. F. Hodge, *Clark University, Worcester, Mass.*

In our present war on the flies the quick, easy and effective method is to catch the breeders, or let them catch themselves. One pair put out of business in the spring may mean bushels less through the summer and fall.

For the large propositions, dairies, stables, slaughter houses, hotel kitchens, markets, and also for other flies, stable, horn, deer or black, bot flies, we need larger and other devices (See plate 1) than the small household flytraps.

Fig. 1 is a first model of a stable cellar window flytrap. It is 32 inches long by 16 inches deep and 12 inches wide, made to fit in the opening of a stable cellar window, the window being removed. The window in the sunniest corner, nearest the stock or manure is chosen, the one about which the flies naturally congregate, and gunny sacks are hung over the other windows. This remains, then, the only light window in the stable or stable cellar and all the flies of every kind go in or out and are caught going or coming. The figure shows the trap after it has been in position for one week at the Worcester Home Farm.

Fig. 2 shows the same trap after the flies have been emptied and measured. This gives more clearly the construction of the trap. The essentials are also given in cross section in Fig. 3, in the diagram fastened to the end of the trap. At the bottom is a crack, about a quarter inch wide, running the length of both sides. This crack admits the flies to a space covered by a ridge or roof of screen wire with holes large enough for flies to go through (punched with an ice pick) every two inches. Large pans of fly bait—fish heads, poultry cleanings, brewers' waste, blood, or anything available which is found on the premises to most powerfully attract flies can be set on the bottom board—and thus establish a whirlwind focus for all the flies about the place. The other essential in the construction is the fold, or folds in the screen walls. These are simply folds, or open pleats running horizontally across the trap, pointing upward and inward. The flies, in trying to get in or out of the window collect in these folds, run back and forth in them until they pop through one of the holes which occur every two inches and they have never been seen to find a hole on the convex, inside, surface of the wrinkle and crawl down and out again.

Fig. 4 shows the trap in position. A cow is close inside this window. The sun shines directly on her, making this a very bright window in an otherwise dark basement. The trap was set in the window, as shown in Fig. 4, from about July 1st until November. It was not baited at all. It picked up about five quarts of flies, 90 per cent of which were stable flies, practically all that appeared on the place. The rest were chiefly horn flies and a single bot fly. There were very few house flies or blow flies, because these had practically all been caught earlier in the season with baited traps. One morning I found the trap swarming with mosquitoes, which had evidently tried to

get in at the cow during the night. A similar trap set in a stable window on a farm on the Magothy River, Maryland, the stable standing in the edge of the woods near a spring and brook, caught thousands of the black or deer flies which were troubling the stock.

In Figs. 1 and 2, which, as stated, are of a first model, it would have been better to have made the folds nearer the top, since the week's catch has choked most all the entrance holes with dead flies.

Here is a trap, the simplest in construction I am able to imagine, which any farmer can make with a little box lumber and screen wire, which will pick up the breeders as fast as they come to the premises, not only of the common house flies but stable and horn flies, black flies and mosquitoes and possibly bot flies. It is still in its experimental stages, but it looks as if it might help to solve some of our most pressing fly problems.

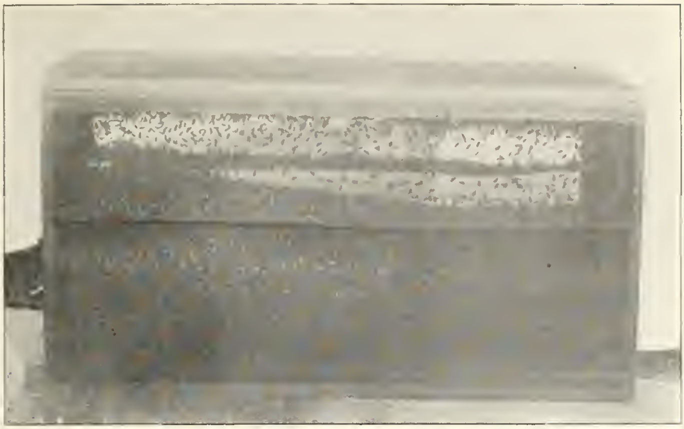
THE STABLE FLY (STOMOXYS CALCITRANS L.), AN IMPORTANT LIVE STOCK PEST

By F. C. Bishopp[1]

The stable fly has long been known as an insect injurious to domestic animals. Considering its almost cosmopolitan distribution and close relation to man, it is strange that so little information has been published on the species. For about half a century practically nothing except unimportant and scattered notes were published on this insect until the appearance of Doctor Newstead's work on "The Life History of *Stomoxys calcitrans* Linn." published in the *Journal of Economic Biology* in 1906. Since the appearance of this paper the important work of Professor Porchinsky, "Recherches Bibliogiques sur le *Stomoxys calcitrans* L. et Biologie comparée des Mouches Coprophagues," was published in 1910. A note of much economic interest was also published in 1909 in the *Bulletin de la Société National d'Acclimation de France* by Lucien Iches.

The recent attention which has been given to the rôle played by insects in the transmission of disease has led many investigators to consider the possibility of Stomoxys acting as vector of a number of diseases of live stock and man. The work of several investigators indicates that the stable fly takes a more or less important part in the transmission of surra of domestic animals, a trypanosomiasis in cattle in Portugese East Africa, souma (*Trypanosoma cazalboui*) of the ox, horse and sheep, *T. pecaudia* of hogs, cats, etc., and anthrax in domestic animals and man. Other workers believe that the fly may in some

[1] Published by permission of the Chief of the Bureau of Entomology.



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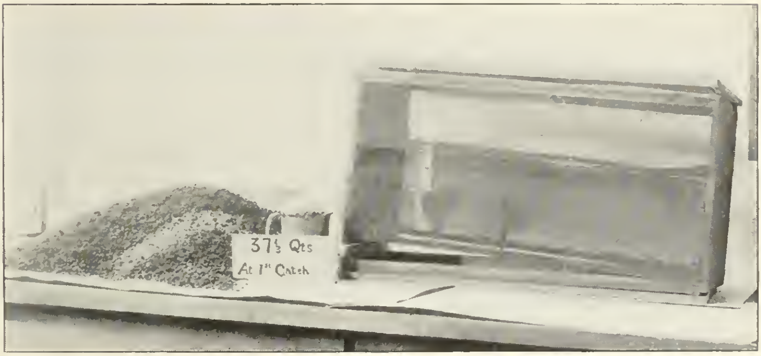

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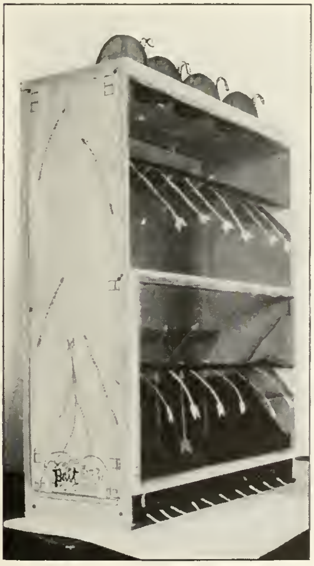

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Fly Traps

cases be connected with the transmission of septicemia in man, glanders in horses and other animals and certain other maladies. In this country the recent work of Brues and Sheppard on the apparent etiological relation between Stomoxys and poliomyelitis and the work of Jennings and King pointing toward the connection of the stable fly with pellagra transmission has had the effect of greatly stimulating the interest of entomologists as well as medical men in the study of this insect, and its possible relation to the transmission of various diseases, the etiology of which has not been fully elucidated. As is now generally known, the conclusions of Brues and Sheppard have been greatly strengthened by the work of Rosenau which demonstrated that the stable fly can transmit poliomyelitis in monkeys. The results of Rosenau have been corroborated by experiments along the same line conducted by Anderson and Frost of the United States Public Health Service.

An Unusual Outbreak of the Stable Fly

About August 14 reports of the occurrence of this species in unusual numbers began to be received from several points in north Texas. The flies appear to have become seriously numerous about August 12, and from that date until the end of August the outbreak continued at maximum severity. The abundance of the insect gradually became less until the middle of October, although an unusual number of flies were present from that date until about the middle of November.

An investigation quickly determined the fact that the flies were breeding in great numbers in straw stacks. The relation between straw and the abundance of the stable fly in this outbreak very closely simulated that described by Professor Iches as occurring in Argentina in 1898, although at the time this investigation was made Professor Iches' work was unfamiliar to the author.

Territory Affected

A survey of the territory made by the writer, assisted by Mr. J. D. Mitchell, showed that the great abundance of the fly was practically co-extensive with the area where grain was extensively produced this year. The abundance was found to be largely governed by the number of straw stacks in a given district. Although flies were found to be exceptionally numerous in areas where practically no oats or wheat were grown, usually such localities were not removed distantly from grain growing areas. The center of greatest abundance was in Grayson, Cook, Collin and Denton counties in northern Texas, however, the severe injury extended as far south as Hill county and west to

Wichita county. In Oklahoma the outbreak was much less severe and, as in Texas, appeared to be confined to localities where grain was extensively grown.

Character of Injury and Losses

Injury to live stock was brought about in a number of ways. Probably the "worry" due to the attack of great numbers of the flies was the most serious and this was a contributing factor to all of the losses sustained. During the period of greatest abundance all live stock were compelled to keep up a constant fight against the flies from daylight until dark. Whether the animals were being driven in small towns, on country roads, worked in fields, or kept in stable or pasture, the flies sought them out and kept up a continual attack. In many cases both horses and cattle became so weakened from this continual worry that they largely gave up fighting and flies swarmed on them in countless numbers. In a number of such cases animals that were not given attention succumbed to the injuries. The loss of blood during the outbreak was by no means a small matter as in many instances as high as a thousand flies were estimated to be present upon a single animal at one time. It was also found that as fast as the flies became filled with blood they would leave the host for a period in order to digest their meal and then renew the attack. It will thus be seen that the blood supply of animals in the worst infested territory must have been heavily drawn upon.

Another, and probably the most important source of loss through the actual death of animals, was the bringing on of acute Texas fever in cattle which already harbored the disease organism in their blood. The development of the disease in these animals was analogous to that which some times occurs in herds which are shipped long distances, exposed to very unfavorable climatic conditions or otherwise weakened, thus bringing on acute Texas fever. In the instances observed the animals were greatly weakened from fighting the flies as well as from loss of blood, thus the disease was given a good opportunity to take hold.

The lessening of the milk supply in all milk cows throughout the affected area was an important source of loss. Dairymen who kept close account of their milk production found that after the advent of the flies their milk output was reduced from 40 to 60 per cent, and in a few cases the cows were completely dried up. Reliable dairymen also assert that since the subsidence of the severe invasion the cows have never returned to their normal milk production.

The loss of flesh in all animals in the fly zone was very noticeable.

Work teams were found to have fallen off from 10 to 25 per cent in weight and fat cattle were in many cases made extremely poor.

The stamping of horses often caused lameness. Swollen and stiff joints were commonly produced by animals standing too long in water to escape the flies.

Another source of loss to farmers was their inability to proceed with their usual farm plowing and other operations at the proper time owing to the impossibility in many cases of working teams in fields. In a number of cases animals were driven frantic and ran away with buggies or wagons or if free in fields often became injured by running into wire fences.

It is difficult to estimate the entire loss due to this outbreak. It is conservatively estimated, however, that in north Texas over 300 head of cattle, mules and horses were killed directly or indirectly by the flies. This loss might be reasonably placed at $15,000, while the loss from other sources far surpassed this death loss.

Importance as a Pest in the United States

Inquiry has elicited the fact that outbreaks of a nature similar but not so severe as the one which occurred in 1912 have been experienced in north Texas a number of times previously. Flies were said to have been extremely abundant in north-central Texas during the latter part of the summer of 1867. Another unusual occurrence of the fly was in 1894 or 1895, and in 1905 the fly was very injurious in certain localities. An investigation of conditions in Kansas and Nebraska indicates that the fly is a pest of more of less importance every year in the grain belt of those states. In some localities in these states it was much worse than usual in 1912. Statements made by farmers in South Dakota and Georgia agree with the information secured in Kansas and Nebraska, and in southern Louisiana the pest was unusually abundant during the late fall of 1912. In Mississippi and South Carolina it occurs commonly and sometimes becomes a considerable pest of live stock. From statements published by Lugger and Washburn this insect must be a pest of importance in Minnesota. Investigations made in central Florida indicate that it is seldom of importance as a pest in that section. Prof. C. P. Gillette says in a recent letter "possibly the common stable fly is really the worst pest (of live stock in Colorado) on account of its being so abundant and ever present." Prof. J. M. Aldrich has given the information that the stable fly is a troublesome pest of cattle in Idaho, and Prof. R. W. Doane has made a similar statement regarding conditions in California.

Hosts

The stable fly does not restrict its feeding to any special hosts. It has been found to feed readily on practically all warm blooded animals, however, certain animals on account of their protective coverings or habits are rather less subject to its attack than are others. Mules appear to be very susceptible to attack and much worried by the presence of the fly.

Horses and cattle are both greatly annoyed. The nervous individuals, however, appear, on account of their frequent movements, to drive many of the flies away. Sheep and goats are both attacked on the legs, but few flies are able to become completely engorged on these animals. Hogs are also commonly bitten, the flies often settling in great numbers just behind the ears. Dogs, cats and chickens have also been seen with flies feeding upon them. Thin haired dogs are exceedingly susceptible to injury and have frequently been seen with blood trickling from the backs of their ears where flies are to be seen most frequently. It is only rarely that the fly attacks poultry, on account of the small surface exposed and the quick movement of the birds when attacked. Man is far from being immune from the attack of this pest. Owing to the lightness with which they sit on the exposed portion of the body and the quickness with which the beak is inserted, they often succeed in piercing the skin though seldom are allowed to become engorged. It has also been observed that they can readily penetrate moderately heavy clothing.

Action of Animals Attacked

As has been stated, the fly usually greatly annoys most animals upon which it attempts to feed. A few of the less nervous individuals permit the flies to engorge without strenuously fighting them, while others may be driven almost frantic. Animals free in pastures have been seen to exhibit various protective actions. When pools of water are within reach they usually enter the water and either lie down or wade into the deep water so as to be largely covered. If only mud is accessible they often stand and lie in this and thus become more or less coated and protected considerably from attack. In open pastures the animals usually come together in a close bunch on a knoll where the breeze is strongest, and there remain for hours stamping and going round and round in an effort to get protection by contact. When shades or stables are accessible the animals often congregate in these, and could hardly be induced to go out to graze for fear of the hordes of flies. Hogs and sheep exhibit habits similar to those of horses and

cattle in regard to securing protection by entering mud or assembling close to sheds or stables.

Life History and Habits

Breeding Places. A somewhat careful examination has shown that the stable fly breeds in the following substances: The list is given in the approximate order of importance. The straw of oats, rice, barley, wheat, horse manure, lot manure and cow manure. It has been determined that pure horse and cow manure are much less attractive to the fly than when a considerable quantity of straw is intermixed. By lot manure is meant the scattered, finely pulverized manure which occurs in barn lots. Examinations of accumulations of weeds have failed to show the presence of Stomoxys larvæ. This is also true of alfalfa hay which was in a rotting condition. The fly has been bred in broken-up upland hay such as is found around the base of stacks or in barns where feeding is done. The vast majority of flies, however, undoubtedly breed in decaying straw, either pure or mixed with manure.

An examination of oat and wheat straw stacks during the latter part of August and early September, 1912, showed that far more larvæ were developing in oat straw than in wheat straw. The former appeared to be more suitable because of its compact texture after being wet and the greater amount of leaves. Most of the flies were breeding in the lower portions of the stacks although a few pupæ were found on the very top of a stack fifteen feet high. After the larvæ develop they show a tendency to work downward, or at least to follow the moisture as the surface of the stack dries. Pupation occurs anywhere in the straw but pupæ are usually more numerous between layers of straw or between the straw and the surface of the ground. At Addis, La., the writer found large numbers of Stomoxys breeding in stacks of rice straw, the conditions under which they were found being quite similar to those in oat straw stacks.

Larvæ have often been observed when small to penetrate between the epithelium layers of the stalk or leaves of grain when moistened in the straw stacks. As the larvæ become larger they often enter the straws and feed within and pupation frequently occurs in this position.

Habits of the Adult. The adults, both male and female, are ready to partake of a meal of blood as soon as the body and mouth parts are thoroughly hardened after emergence. The host appears to be located largely by sight and on cattle the fly has been frequently seen to alight on the back and as soon as disturbed by the switching of the tail it flies directly to the outside of the forelegs just below the

knee. This is the situation usually chosen by the fly in feeding on bovine hosts, apparently on account of the relative freedom from attack by the tail or mouth of the host and the comparative shortness of the hair which permits of easy penetration. On horses the flies feed in greatest numbers on the lower parts of the legs, sides of the neck and under the belly, although when an animal is in harness they commonly feed on all parts of the body not readily reached by the tail.

The bite of the fly is quite painful, the first insertion of the beak being accompanied by a sharp, piercing pain. As the proboscis is worked in further there is usually a series of more or less sharp pains accompanied by itching. After the beak is inserted and feeding begins there is usually no discomforture. Feeding is ordinarily completed in from two to five minutes after the beak is inserted. After the fly has once begun drawing blood it is usually not easily disturbed and continues to feed until replete. When the fly is well filled excretion of from one to several minute drops of a clear liquid usually takes place. When the beak is withdrawn the fly goes through a series of cleaning operations and flies away at the first sign of motion of the host. Following the withdrawal of the beak a drop of blood usually exudes. Little or no itching follows the bite although sometimes a minute reddish spot is visible for a day or two. When fully engorged the abdomen is tremendously distended and flight is comparatively slow and heavy.

For some time after feeding the flies are comparatively sluggish and remain motionless on any nearby object. In open fields and along roadways they were often seen during the recent outbreak in great numbers beneath the surface of leaves of plants where they had gone for protection from the sun during hot days, and hundreds of specimens were often to be seen on the foliage of trees up to a considerable height. Hundreds of them have often been observed resting on the shady sides of barns and silos. During this resting period the blood digests rapidly and the voiding of the clear liquid excrement occurs at intervals of a few seconds. After a few hours this excrement becomes darker and less liquid, leaving a black spot where it dries. During the outbreak described the weather boarding on houses and barns was in many cases thickly spotted with this excrement.

During moderately cool weather feeding usually takes place each day. When the weather is warmer digestion proceeds faster and flies may engorge twice during one day. In some cases individuals which are disturbed during their meal will persist until they have become completely engorged, while others which are less persistent finally leave the host when only partially fed. Flies have been observed to pass

freely from one animal to another many times before becoming replete, thus giving an opportunity to convey disease mechanically.

On account of the probable relation of this insect to the transmission of a number of diseases, the study of its feeding habits in relation to climatic conditions is important. It has been found that adults will feed in midday during extremely hot weather and also when the temperature is as low as 55 degrees Fahrenheit. The minimum feeding temperature may be even lower than this. During rainy weather the flies are largely driven into sheltered places. This accounts for the presence of adults which has been observed heretofore in the habitations of man at such times. The flies have not been observed to be more persistent in their feeding during cloudy weather than in clear weather although they continue to attack hosts during showers or cool, drizzling rains. The fly may also bite by artificial light when free in a room.

Reproduction. In a large series of tests flies have been found never to deposit before the third feeding on blood and usually four engorgements are necessary. There is no indication that reproduction ever takes place unless blood is engorged, however it is a common habit of flies to partake of other liquid food. During deposition they frequently feed upon the moisture on rotten straw and also have been observed to take up moisture from manure as well as to drink freely from plain or sweetened water when it is supplied to them in confinement.

After the third or fourth feed, when the blood has been digested, the flies seek suitable places for depositing their eggs. Deposition has been observed both in confinement and in the field. Upon opening a straw stack which had become dry on the surface, thus exposing the rotting portions beneath, the flies immediately assembled and sometimes crawled down into the straw to a depth of several inches and began laying eggs. These may be laid singly or in bunches of as many as twenty-five or thirty. The ovipositor is greatly extended and used as a tactile organ in order to find a crevice in which to place the eggs. During active depositon from seven to nine eggs are deposited per minute and the entire mass is usually deposited in less than half an hour. Immediately after depositing the females are ready to feed again and this feeding is usually followed within a day by another deposition. The greatest number of depositions observed by a single fly was three, a total of 278 eggs being deposited. Frequently two feedings are necessary after a given deposition before another lot of eggs is laid. As the temperature becomes lower greater numbers of feedings are required to produce the same number of depositions. In one instance a female was engorged more or less completely fourteen

different times and deposited two lots of eggs. In another instance a female which did not have access to males was engorged twelve times, no eggs being deposited.

TABLE I.—RECORDS OF FEEDING AND DEPOSITION

First Feeding Period	Deposited		Date Fed	Deposited		Date Fed	Deposited		Total No. Eggs
	Date	No. eggs		Date	No. Eggs		Date	No. eggs	
Oct. 5–7	Oct. 8	71	Oct. 8	Oct. 9	105	Oct. 10	Oct. 11	102	278
"	"	99	"	"	97	"	lost	..	196
"	"	89	killed	..	..	..	..	..	89
"	"	122	Oct. 9	lost	..	..	..	..	122
"	Oct. 9	96	killed	..	..	..	..	..	96
"	"	66	Oct. 9	Oct. 11	109	lost	..	..	175
"	..	..	"	"	57	Oct. 11	Oct. 13	51	108
Oct. 25–29	Oct. 30	50	Oct. 30	Nov. 1	23	Nov. 3	died	..	73
"	"	109	"	Oct. 31	120	Nov. 1	"	..	229
"	"	111	"	Nov. 1	109	Nov. 3	"	..	220
"	..	..	Oct. 31	Nov. 3	78	"	Nov. 4	88	166
Oct. 25–30	..	..	Nov. 4	Nov. 5	20	Nov. 6	Nov. 7	52	72

The accompanying table shows the number of eggs deposited by several females upon which egg counts were made. Other individuals

fed at the same time failed to deposit any eggs. Several of the flies, the deposition of which is recorded in the table, fed one or more times after the last deposition recorded but did not deposit subsequently.

Experimental evidence indicates that fertilization does not take place until after the flies have partaken of blood. Copulation has been observed but a very few times. In the instances noted the act took place some time after the flies had been fed, the duration of the act being about five minutes. In one instance a fly deposited fertile eggs without copulating with the male after the first deposition.

Longevity of Adults. Flies kept in close confinement without food or water die within two days. When water and sugar syrup were supplied to flies in a cage about one foot square a single female, of a lot of about fifteen males and females, survived for twenty-three days. Individuals which were fed on blood at rather short intervals lived seventeen days. It has also been noticed that when fruit or moist straw is supplied the length of life of the flies frequently reaches ten days.

Duration of Stages. The length of the egg stage has been found to vary from one to four days. Temperature and humidity, as well as the length of time eggs are retained by the female, appear to markedly affect the rapidity of incubation. The larval period has been found to vary from about eleven to over thirty days. Records made during cold weather would doubtless show this stage to be much longer. The suitability of food also decidedly affects development. As is shown in the accompanying table the minimum developmental period from egg to adult ranged from twenty-three to thirty-two days, according to the character of the food supplied. The pupal stage varies from six to about twenty days and the total period from egg to adult from nineteen to over forty-two days.

It has been found that abundance of food hastens development considerably. This is brought about in two ways, namely, by enabling the larvæ to choose suitable portions of the food, and where there is a large amount of straw or other food material in a pile the heat generated stimulates development. Even during the late fall in north Texas, when the minimum temperature reached thirty degrees, frequently the straw where larvæ were found to be developing was very warm. In larger stacks this heat may persist through the winter.

Hibernation. No notes have been made on hibernation but examinations of stacks in the middle of December show an abundance of larvæ in various stages of growth and many pupæ. Adults have also been found active and feeding on animals on December 18. It is thought that adults may be more or less active in southern latitudes during warm periods throughout the greater part of the winter, and

no doubt emergence of adults continues during most of the winter months. Probably most of the individuals which successfully hibernate in the latitude of Dallas pass the winter in the larval and pupal stages.

TABLE II.—DURATION OF STAGES AS RECORDED AT DALLAS, TEXAS, IN 1912

Eggs Deposited	Hatched	Incubation Period	Pupated		Larval Period	Adults Emerged		Pupal Period	Total Period—Egg to Adult
			First	Last		First	Last		
		Days			Days			Days	Days
..	..	..	Sept. 9	..	..	Sept. 17	Sept. 18	8–9	..
..	..	..	Sept. 10	..	..	Sept. 18	Sept. 20	8–10	..
..	..	..	Sept. 11	..	..	Sept. 19	..	8	..
Sept. 14*	..	..	..	..	..	Oct. 7	Oct. 15	..	23–31
Sept. 14*	..	..	..	..	..	Oct. 11	Oct. 19	..	27–35
Sept. 14*	..	..	..	..	..	Oct. 10	Oct. 20	..	26–36
Sept. 14*	..	..	..	..	..	Oct. 16	Oct. 21	..	32–37
Sept. 14	..	..	Oct. 1	..	17	Oct. 7	..	6	23
Sept. 15	..	..	Oct. 1	..	16	Oct. 7	..	6	22
Sept. 15	..	..	..	..	..	Oct. 4	..	..	19
Sept. 22	Sept. 24	2	..	..	..	Oct. 12	Oct. 19	..	20–27
Sept. 23	Sept. 25	2	About Oct. 6	Oct. 12	11 ±–17	Oct. 12	Oct. 18	6 ±	19–25
Oct. 8	Oct. 9	1	Oct. 28	Nov. 1	19–23	Nov. 5	..	8	28
Oct. 9	Oct. 11	2	Oct. 27?	Nov. 1	16?–21	Nov. 4	Nov. 21	8–20	26–43
Oct. 11	Oct. 13	2	Nov. 6	After Nov. 22	24–30+	Nov. 17	After Nov. 22	11–16+	37–42 +
Oct. 30	Oct. 31	1	..	..	..	Dec. 1	..	..	32

* The first of this series of records was made with rotten oat straw as a breeding medium; the second, cow manure; third cow manure pulverized in lot; fourth broken up hay.

Relation Between Grain Crop, Rains and Abundance of the Fly. As has been pointed out, this insect is usually much more numerous during the late summer and early fall months. When we come to understand the breeding habits of this species this condition is readily explained. A study of the recent outbreak in Texas clearly shows that the unusual abundance in August and September was due to the large crop of grain, incidentally producing a great number of straw stacks, combined with the unusually heavy rains in early August (at Dallas, Texas, 6.47 inches of rain fell). Many stacks were recently thrashed and, being loosely piled, absorbed the rains as they fell. In a few days the entire mass became rotten and heated and thus afforded precisely the conditions which are most desirable for the reproduction of Stomoxys. It has also been found that during other years of unusual abundance of this pest, the large grain crop and summer rains have been the principal contributory factors.

In Texas the activity of many adults has been observed rather early in the spring. On May 18, 1912, the fly had become sufficiently numerous at Dallas to greatly annoy cattle. During the latter part of May it was found by Mr. Wood to be present in numbers at Abilene, Texas. The flies which appear in the spring and early summer breed largely, no doubt, in straw stacks of the previous year and in straw used in feeding and bedding animals.

Natural Control

Climatic Influences. As has been mentioned, the presence or absence of moisture in the breeding places of this species has a very potent influence on development. The larvæ are able to withstand a great amount of moisture, often feeding on straw which is saturated with water and thus being themselves largely submerged. It has been found, however, that where there is a considerable depth of water above the larvæ they soon stop feeding and become dormant, not being able to stand this condition more than a number of hours. The young larvæ are much more susceptible to injury by extremes of moisture and temperature than are the well developed ones. In the case of the latter pupation is often hurried as a result of these exposures. Larvæ have often been observed, when quiescent on account of lack of moisture, to become active and resume feeding after water is supplied. The pupæ are much more resistant to the effects of both moisture and temperature extremes. Light also has a very marked influence on the development of larvæ, particularly when they are small. In no case have larvæ been induced to complete development when kept in tubes and exposed to bright light. As has been discussed under habits

of the adult, feeding may take place at very high temperatures. Below 55 degrees the flies become more sluggish and show less desire to feed and dormancy appears to occur between 40 and 49 degrees. Temperatures of 27 degrees are not fatal to the adults. When dormant flies are placed in the direct sun they become active much more quickly than when kept in the shade at the same temperature.

The drying out of straw stacks to a depth of six or eight inches largely prevents the deposition of eggs in these situations, the stacks under these conditions being unattractive to the adult fly.

Parasites and Predaceous Enemies. In the breeding of material from various points in the Southwest, parasites have been found in pupæ in a number of lots of Stomoxys. Two small Hymenopterons of the family Pteromalidæ have been found in numbers. One of these is *Spalangia muscæ* and the other is in a different genus although a definite determination of it has not been made. *S. muscæ* has been bred from Stomoxys pupæ collected in a horse manure pile at Wellington, Kans., by Mr. E. O. G. Kelly and the writer, a few specimens from material collected in straw at Gainesville, Texas, and large numbers from straw heavily infested with Stomoxys at Dallas, Texas. Pupæ obtained in rice straw by the writer at Addis, La., were also parasitized but the adults have not yet emerged. In a quantity of straw kept in the laboratory yard at Dallas for the purpose of breeding Stomoxys, it was estimated that about 40 per cent of the pupæ were parasitized by these two species. This estimate was based on an examination by Mr. Harry Pinkus and the writer of all the pupæ in the straw, which numbered some 2500. In breeding experiments it has been determined by Mr. Pinkus that parasitism always takes place in the pupal stage. Both of the parasites have been found to attack the pupa of the house fly (*Musca domestica*) and the horn fly (*Hæmatobia serrata*), as well as other mucid pupæ.

During the outbreak of this insect predaceous insects were present in large numbers. Adults of Stomoxys were found to be captured by several species of Asilidæ which were present in great numbers around straw stacks. Several species of spiders were observed in the act of capturing and devouring adult flies. Two or three species of mites were also found to be enemies of the immature and adult stages of Stomoxys. In manure and straw histerid beetles were among the more important predators. Chickens and other domestic fowls, hogs and mice were found to destroy the larvæ and pupæ of this insect in great numbers. The chickens and hogs were attracted to the straw stacks mainly by the presence of grain, but they evidently devoured large numbers of the immature stages of the fly while searching for grain.

Artificial Control

Destruction of Breeding Places. Since straw stacks have been found to be the principal breeding places of this insect in the grain growing belt, attention should be given to the care of straw as the most important step in control. In general, it is the practice throughout the grain belt for farmers to stack the straw by the use of self-stacking threshing machines. After the threshing is done no attention is paid to the care of the stack until a year or two after when in some instances it is burned, in other cases the new straw is stacked on top of the old piles. These practices are bad, not only on account of the breeding of Stomoxys and other flies, but the full manurial value of the straw is not secured and a considerable amount of valuable land is occupied continuously by the large and often scattered stacks of straw. In many cases it has been found that these stacks occupy as much as a hundred yards square of tillable soil. On account of the fact that straw is depended upon by many farmers to supplement their other food supply for live stock during the winter, a general recommendation to burn the stacks immediately after threshing is not practicable. All the straw which is not required for winter feed for cattle should be destroyed by burning or scattered over the land soon after threshing and plowed under subsequently. Oat straw is usually used for feeding purposes. It should be remembered that this also forms the most favorable breeding medium for Stomoxys. It is therefore recommended that the straw for feeding and bedding purposes be baled and stored under cover. Where this is not practicable the stacks should be rounded up so as to make the top largely rain proof and the sides almost vertical.

It should be borne in mind that under conditions similar to those which prevailed during the summer of 1912 the straw stacks are largely rendered unfit for food owing to the thorough wetting by August rains, and are, therefore, of little value except for fertilizing purposes. In such instances where the flies are already breeding in uncared-for stacks they should be promptly burned or scattered. If the scattering is done thoroughly the exposure of the straw to drying and light will effectually stop the breeding of the flies.

Where headers instead of binders are used the straw question is less important as most of the straw is left in the field and later plowed under. The destruction of the chaff and the short straw taken by headers can readily be disposed of as indicated above.

The use of poisons is not advisable as quantities sufficient to permeate the stacks and kill the larvæ would be very dangerous to stock

and equally as expensive as the disposition of the stack in some other way.

Whenever manure is mixed with any amount of straw it may be suspected of forming a breeding place for Stomoxys. The thorough scattering of manure at regular intervals as is recommended for the control of the house fly is effective in stopping the breeding of Stomoxys. Accumulations of straw, hay or manure should not be allowed about fence corners and barns as all of these situations are utilized by the stable fly for breeding when large manure piles and straw stacks are not available.

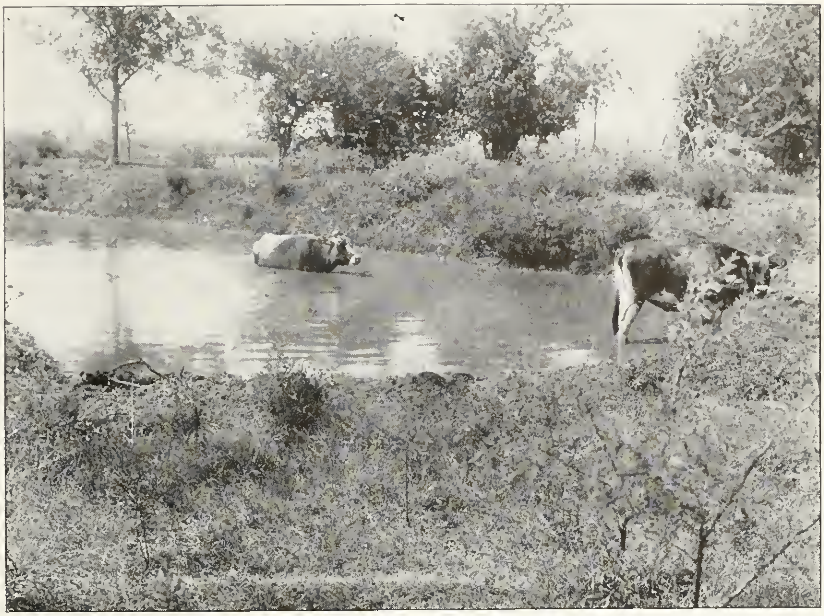
Protection of Stock. The protection of work animals by means of coverings lends much protection from the attack of this pest. The most effective and inexpensive covering observed during the recent outbreak was a blanket made of a double thickness of burlap so arranged as to completely cover the back, sides and neck, and the covering of the legs by means of trousers slipped on over the feet. The latter can be made of burlap or old trousers be utilized. When fastened together over the shoulders and back or attached to the harness, the animal is almost completely protected from the flies. Leather nets or other coverings should also be applied to the head.

A large number of repellent decoctions were tried during the recent outbreak. None of these gave more than temporary relief and some proved injurious to the animals. A mixture of fish oil, oil of tar and oil of pennyroyal with a little kerosene added proved to be the most efficacious.

Where stables are exceedingly dark they offer much protection from fly attack. The thorough screening of barns also gives a large degree of immunity. In this case the flies should be brushed off the animals when they enter the barns by means of nets over the doorway or by brushing the animals with sacks as they enter. Screened barns have a great advantage over dark ones because they admit light and air whereas darkened barns are extremely hot in summer.

Plowing rather deep, narrow trenches offers much protection to hogs from fly attack. The sides of these trenches may be oiled with petroleum. By this means the hogs, which readily take to these trenches when attacked by the flies, become oiled on their sides and backs which adds to their protection. This form of trench may also be used to protect sheep as it allows them to cover their legs where the flies can best reach them.

Stable Fly.



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Stable Fly Conditions.

Proceedings of the Eleventh Annual Meeting of the American Association of Official Horticultural Inspectors

The Eleventh Annual Meeting of the American Association of Official Horticultural Inspectors was held at Cleveland, January 2 and 3.

For convenience, the business transacted at the meeting will be reported first, which will be followed by the papers and discussions.

PART I

The first session was held in the parlors of the Hotel Euclid, Thursday evening, January 2. The meeting was called to order at 8 p. m. by President T. J. Headlee, with T. B. Symons, Secretary. Among the inspectors and visitors were present the following:—

T. J. Headlee, New Brunswick, N. J., H. E. Summers, Ames, Iowa, F. L. Washburn, Minneapolis, Minn., George G. Atwood, Albany, N. Y., W. E. Britton, New Haven, Conn., T. B. Symons, College Park, Md., C. L. Marlatt, W. O. Orton, Peter Bissett of Department of Agriculture, Washington, D. C., A. F. Burgess, Melrose Highlands, Mass., P. A. Glenn, Urbana, Ill., C. H. Baldwin, Indianapolis, Ind., George A. Dean, Manhattan, Kans., L. M. Peairs, Morgantown, W. Va., Enos B. Engle, Harrisburg, Pa., W. J. Schoene, Geneva, N. Y., P. J. Parrott, Geneva, N. Y., L. Caesar, Guelph, Ontario, Henry H. Severin, University of Wisconsin, Madison, Wis., H. C. Severin, Brookings, S. D., S. J. Hunter, Lawrence, Kans., Alfred C. Burrill, Madison, Wis., S. C. Clapp, Department of Agriculture, Raleigh, N. C., R. W. Braucher, Kent, O., H. J. Quayle, Berkeley, Cal., W. W. Yothers, Orlando, Fla., W. D. Hunter, Washington, D. C., Mel T. Cook, New Brunswick, N. J., J. G. Sanders, Madison, Wis., E. P. Felt, Albany, N. Y., H. E. Morris, Bozeman, Montana, Y. H. Tsou, Urbana, Ill., H. T. Osborn, Columbus, O., R. S. McKay, Owensville, O., E. W. Mendenhall, Columbus, O., C. W. Waid, Springfield, O., H. D. Leach, Delaware, O., J. H. Dayton, Painesville, O., H. E. Evans, Columbus, O., A. W. Morrill, Phoenix, Ariz., T. H. Parks, Greenwood, Miss., J. F. Zimmer, Washington. D. C., F. M. Rolfs, Ithaca, N. Y.

Plate 2.—*Stomoxys calcitrans*. Fig. 1.—Adult (dorsal view) enlarged x6.7. Fig. 2.—Fly soon after emergence showing ptilinum extended, enlarged x6.7. Fig. 3.—Eggs, enlarged x49. Fig. 4.—Eggs on rotten straw, enlarged x6.7. Fig. 5.—Pupæ within a straw, enlarged. Fig. 6.—Adult engorged with blood, enlarged x6.7. Fig. 7.—Puparia showing fractures due to emergence of flies, enlarged x6.7. Fig. 8.—Larvæ (upper, ventral; lower, dorsal view) enlarged x6.7. (Original Photos by H. P. Wood).

Plate 3. Fig. 1.—Cows in water to avoid the attacks of the stable fly. Fig. 2.—Horses with one form of covering used to protect them from stable fly attacks (Original Photos by F. C. Bishopp and H. P. Wood).

REPORT OF SECRETARY-TREASURER

The work of the Association has progressed satisfactorily during the past year:— New members have joined the Association, but there are several on the roll of the Association who have not paid their dues.

With the passage of the Plant Quarantine Law, there is an added necessity for an annual conference of State Horticultural Inspectors, to study and discuss the best means of conducting our work with justice to all parties.

The Association is now on a good working basis, and I hope that the proposal of affiliation as a section of the Association of Economic Entomologists will meet with the approval of the members of each Association.

In any event, I beg to be relieved of the duties of Secretary-Treasurer on account of increased demands on my time in Maryland. According to the by-laws, I believe there remains one more year of my term of office.

As your treasurer I submit the following statement, giving a balance to the treasury of $45.27.

Respectfully submitted,

T. B. Symons.

STATEMENT

T. B. Symons, In Account with American Association of Official Horticultural Inspectors.

By Balance				$16.27
By Dues (May to December)				44.00
Credit for bills not paid—1911 statement				12.00
				$72.27
1912:				
#1.	Feb. 6.	To A. W. Myers, stenographic work	$4.50	
#2.	April 7.	Jr. Economic Entomology, printing separates, legislative article	9.50	
#3.	Dec. 20.	Anna E. McCarthy, stenographic work	6.00	
#4.	" "	T. B. Symons, stamps	5.00	25.00
				$47.27
		Debit by check returned		2.00
		Balance to Dec. 21, 1912		$45.27

The report was accepted.

The Chairman of the Committee on Affiliation, Prof. T. B. Symons, submitted the report of the committee, which was similar to the report submitted by the committee to the Association of Economic Entomologists. See Page 20.

After a discussion the report was adopted.

After a discussion of the desirability of having uniform state laws, the President was authorized to appoint a committee to draw up a model law for presentation at our next annual meeting.

The President appointed Messrs. C. L. Marlatt, Franklin Sherman, Jr., and J. G. Sanders.

The following report of the Legislative Committee was adopted and the committee discharged.

REPORT OF COMMITTEE ON LEGISLATION

Mr. Chairman and Members of the Association:

Your committee begs to report that it coöperated with other committees of Associations interested in National Legislation, and with the Officers of the U. S. Department of Agriculture, in securing the passage of the Federal Plant Quarantine Law. Many meetings and conferences were held with parties interested while the bill was pending the last session of Congress. After an agreement regarding the provisions of the bill had been reached, the Officers of the Bureau of Entomology, especially Mr. Marlatt, were untiring in their efforts to have the legislation enacted by Congress.

While the bill as passed is not perfect, it is hoped that the discussion of this legislation at these meetings will be helpful in suggesting any amendments that may be necessary in the future, for the greatest protection to this country, against imported insects and diseases, with the least hardship upon the importers.

Respectfully submitted,

T. B. Symons.
E. L. Worsham.
H. A. Surface.

REPORT OF AUDITING COMMITTEE

Mr. Chairman:

Your committee reports that it has examined the books and vouchers of the Treasurer and found them correct.

J. G. Sanders.
W. C. O'Kane.

REPORT OF COMMITTEE ON RESOLUTIONS

Whereas, the establishment of the Federal Horticultural Board is a great advance in improving the horticultural inspection service of the United States, and believing that there should be the fullest possible coöperation between this Board and the State Inspectors,—therefore,

Be It Resolved: That we express our appreciation of the presence at this meeting of the members of the Federal Horticultural Board: that we are willing and desirous of conferring and coöperating with the Board so far as local conditions permit.

Be It Further Resolved: That we employ for inspectors when possible, men of a high standard of integrity and intelligence and of more ample training and experience with both insects and plant diseases.

Whereas, certain insects and plant diseases are considered dangerously injurious in some States or Countries and not in others, it seems necessary that some publication be issued giving brief illustrated accounts of the various pests,—

Be It Resolved: That the President appoint a Committee of three to confer with members of the Federal Horticultural Board and request the Board to issue such a publication.

W. E. Britton, *Chairman.*
George G. Atwood.
H. E. Summers.

The report of the Committee was adopted.

REPORT OF NOMINATING COMMITTEE

Mr. Chairman:

Your committee after considering the action taken by this Association and the Association of Economic Entomologists, recommends that Mr. J. G. Sanders be selected for permanent Secretary for our section. The First Vice-President, Prof. E. L. Worsham, of the Economic Association will serve as the Chairman for our next meeting.

Respectfully submitted,

F. L. Washburn.
T. B. Symons.
N. E. Shaw.

The report of the Committee was adopted, and it was moved and carried that the Secretary cast the ballot for the election of Professor Sanders for Secretary.

This concluded the business transacted at the meeting.

PRESIDENT'S ADDRESS

By T. J. Headlee, *New Brunswick, N. J.*

Fellow-members of the American Association of Official Horticultural Inspectors:

Your president desires to express himself as deeply appreciative of the honor that you have seen fit to confer upon him. It has not been customary for the chairmen of this body to make lengthy addresses and it is not purposed to violate the custom in this instance.

Your chairman desires to invite your attention to an interpretation of the duties of the horticultural inspection service based on a fundamental conception of the end it is to serve and to make certain suggestions for its improvement.

The origin and distribution of animal and plant species in a state of nature has been in progress from earliest time. Nature in the form of climatic factors and physical features has set the bounds of the distribution of each species. In general, species arise and distribute themselves as widely as these factors operating on them directly and through their food plants and their enemies, indirectly, will permit. It is, therefore, to be expected that, climate not forbidding, the insect and fungous enemies of the specific plant will usually be able to follow it to the ends of the earth.

When man began to transport plants from all parts of the world, he incidentally carried along their insect and fungous enemies. Considering our own country, the plants usually came fairly free from their enemies; but repeated importations finally brought them in sufficient

numbers to form destructive pests. Usually the damage done by them to their old food plants has been greater than that which ordinarily took place in the country from which they both came, and has continued to be so until their predaceous and parasitic foes have become sufficiently numerous, or native forms have learned how to use the pest or both. Not only have the injurious species imported with specific plants attacked these plants; but in some instances they have found native plants to their liking. Incidental to the importation of plants, species of injurious insects and fungous diseases not in any way injurious to the specific plants with which they came have been brought in. Some species coming to us in this way have proven very injurious to other species of useful plants.

If this process of distribution be allowed to go on it seems entirely probable that every injurious insect and every fungous disease will become as widely distributed throughout the earth as the climate will permit, because man has removed the physical-feature barrier.

It is the business of the inspection service to discover the injurious forms that are thus being distributed and to take such measures as will prove a barrier to their further spread. This duty the service has well understood and has tried to fulfill. Unfortunately, with very few exceptions, all efforts toward stopping the distribution of serious insect pests and plant diseases have resulted, or promise to result, merely in delaying the spread of the organism. This result has, of course, been due to a variety of causes; but chiefly to the fact that natural forces operate for twenty-four hours every day in the year and every year in the century, while horticultural inspection operates only intermittently. In the light of past experience, it seems probable that the distribution of every injurious insect and every plant disease will coincide with that of its food plants in so far as climate will permit, and that all the horticultural inspection service will be able to do will be to delay the distribution of dangerous species until their normal environment of enemies can be developed and efficient artificial measures for their control discovered. It is well to recognize our limitations and not allow ourselves in the heat of argument before committees on appropriations to promise eradication if only enough of the "sinews of war" is put into our hands.

Whether the inspector will or no, the general public and the fruit grower look upon his certificate as a guarantee of freedom from injurious insects and plant diseases. It seems likely that the time is not far distant when in his full capacity of nursery, fruit planting and fruit inspector, the official horticultural inspector will be held responsible by the public for the sort of fruit with which it is fed. Your present chairman is in entire sympathy with the contention of our ex-president

and fellow member, Mr. Franklin Sherman, Jr., of North Carolina, that the certificates which we issue should mean exactly what they say. The business should be so managed that the certificate should be a guarantee in fact as well as in opinion.

The official horticultural inspector clearly owes a service to the nurseryman, for he is an absolutely necessary factor. The inspector should so clean up the nurseries and their environs in his charge that clean stock from clean starts can be produced. He should make such arrangements that his nurserymen can obtain clean scions, buds, etc., from tested sources. Having made the production of clean stock possible, he should then see that every nurseryman produces that kind of stock.

The horticultural inspection service should see to it that the dealer in nursery stock handles only that which comes from clean sources and that the same regulation is enforced where the importer is concerned.

This past year has brought the enactment of a national inspection law, and some have this, the first year of its operation, found that it permitted them to protect their states better than has hitherto been possible.

The interrelation between the national and state arms of the inspection service should be one of courteous coöperation. The present method adopted by the Federal Horticultural Board of having inspections within the limits of the states made by state inspectors, is one to be commended and one that should be continued. A little more of personal contact between the administrators of the national and state laws would lead to better understanding of plans and aims, and is highly desirable.

The horticultural inspection service now needs to initiate a campaign of education on the danger of carrying plants in trunks, bags, or bundles in hand from one locality to another. This form of distribution we appear at present to have no other method of meeting.

There are many mooted questions concerning the importance of this or that insect and of this or that plant disease. This association should make some provision, as by means of a standing committee, for an annual summarizing of the status of information with regard to the importance of each of these insects and diseases to horticulture in the various states of this country. The first duty of such a committee would be to obtain by inquiry a concensus of opinion of the service on just what are the insects and diseases feared in the different sections of this country. The second duty would be to summarize and present the evidence on the dangerous nature of the doubtful forms, their present distribution, and the means of preventing their spread.

There is a fundamental weakness in the present inspection service in that too few of our inspectors are trained plant pathologists. A few states have already provided men thoroughly trained both in injurious insects and plant diseases, and your chairman believes that this association should go on record as favoring this type of service.

In closing these remarks it should be said:

1. That the general public and the fruit grower regard the inspector's certificate as a guarantee and the proper way to meet this responsibility is to make the certificate mean exactly what it says.

2. That the inspector should so clean up the nurseries and environs under his charge that his nurserymen can start with clean material and grow clean stock; that he should provide tested sources of growing material, and that he should then require his nurserymen to produce clean stock only.

3. That a standing committee from this association should be appointed for the purpose of summarizing the opinion of the service as to the seriousness of the various insects injurious to horticulture in the different parts of this country and for the purpose of summarizing annually the status of knowledge and opinion on the importance of insect pests and plant diseases about which there exists doubt, or that some other adequate provision should be made for placing this information in the hands of the inspectors.

4. That this association should go on record as favoring an inspection service composed of men properly trained in both injurious insects and plant diseases.

THE FEDERAL PLANT QUARANTINE ACT

By C. L. Marlatt, *Chairman Federal Horticultural Board*

Quarantine Orders

The act of August 20, 1912, was immediately effective as to certain quarantines, but not effective as to nursery stock until October 1. The following quarantine orders were promulgated as promptly as was possible under the provisions of the act:

No. 1. White Pine Blister Rust, September 16, 1912.

No. 2. Mediterranean Fruit fly, September 18, 1912.

No. 3. Potato Wart, September 20, 1912.

No. 4. Gipsy and Brown-Tail Moth, November 5, 1912.

Two of these are foreign orders and are absolute prohibitions of the entry of the goods covered, namely, the quarantine relating to the white pine blister rust and the quarantine relating to the potato

wart. These quarantines have effectually excluded the articles covered, and, through the hearty coöperation of customs officials, at a negligible cost to the government.

The two domestic quarantines, namely, (1) against the Mediterranean fruit fly in Hawaii and (2) against a portion of New England on account of the gipsy and brown-tail moths, are in good working order. The Hawaiian quarantine is being enforced with the coöperation of the quarantine officials of the Territory of Hawaii and of the Pacific Coast States, notably California, at practically no cost to the Federal government. The heartiest of coöperation has been rendered both by the Territory of Hawaii, which is directly affected, and by the Pacific Coast States, as also by the transportation companies and customs service.

The New England quarantine has only recently been established, but it promises to cause comparatively little friction and difficulty. It is being administered in coöperation with State Horticultural Inspection officers under the appropriation for the Prevention of Spread of Moths, and therefore does not draw on the funds appropriated for the Plant Quarantine Act. This New England work is closely in line with the work being done under the appropriation for the Prevention of the Spread of Moths, and it seems therefore perfectly legitimate and proper to have it carried by this fund and the existing New England force working thereunder.

Notices have been recently issued on two proposed additional quarantines. One of these is in relation to the Mexican orange fruit fly, calling for a hearing on the subject at the Department of Agriculture, January 8, 1913; and the other is in relation to imported sugar cane, the hearing being called for at the Department of Agriculture, January 7, 1913. In addition to these, quarantine of some sort will probably ultimately be taken covering fruits from the Mediterranean countries occasionally imported into the United States which are known to be infested with the Mediterranean fruit fly in their place of origin, and similar quarantine of transpacific countries in relation to the Mediterranean and other fruit flies. The latter quarantine will be merely an extension of the Hawaiian quarantine to other Pacific islands and transpacific countries known to be infested with the Mediterranean fruit fly, from which fruit is occasionally brought as ship's stores or otherwise to Pacific ports.

Control of Importation of Nursery Stock

While there has necessarily been a good deal of misunderstanding and some confusion incident to the installation of the new system of

control of the importation of nursery stock from foreign countries, the provisions of the Act and the regulations drawn thereunder are coming to be better understood. After a little over two months' experience and with the corrections which will be made as a result of that experience, there is every promise that this service will work out successfully, and give in large measure the protection needed. The heartiest of coöperation has been received from the Customs Division of the Treasury Department and this division has worked with the department to develop and perfect methods which will give all the information and protection possible under the Act.

The general effect of the enforcement of the Federal Act has been very helpful in stimulating better state inspection work, and encouraging steps are being taken in several states to secure suitable legislation and appropriation for such work. This interest has been very considerably augmented by the discovery, as a result of information obtained as an outcome of the act, of the entry of infested nursery stock into several states.

The Federal Act has also very greatly stimulated foreign countries to do better work of inspection and to provide suitable legislation to meet the requirements of the Act. The result of this is already shown in the better quality of imported nursery stock and its general freedom from infestation.

General Post Office Coöperation

The Postmaster General has coöperated very heartily with the Department of Agriculture in adjusting the postal-service and issuing special orders to facilitate the enforcement of the Plant Quarantine Act in relation to nursery stock or other plant products shipped through the mails. He has ordered that all packages containing nursery stock or other plant products covered by the Federal Plant Quarantine Act or quarantines promulgated thereunder, shall be plainly marked, indicating contents, the names of the sender and consignee, as well as the destination, and that each shall bear a certificate of inspection. This applies both to domestic and foreign shipments.

The postal services of foreign countries have been notified of the requirements of the Federal Plant Quarantine Act, and postmasters of this country who may receive imported nursery stock have been notified of the requirements under the Act, which are a condition of entry and delivery of such stock.

Special notification has been given to all postmasters of Hawaii, advising them of the Mediterranean fruit fly quarantine, to prevent any fruit being shipped through the mails in violation of this quarantine. Similar notification has been sent to postmasters in New Eng-

land in relation to the gipsy and brown-tail moth quarantine. An order has been issued permitting postmasters to notify the proper state officials of the arrival and delivery of nursery stock, so that such state officials may, if they see fit, make examination of nursery stock thus imported through the mails. This last has been one of the loopholes which was most difficult to cover on account of the theory of the inviolability of mail matter. All of these orders of the Post Office Department are given in an appendix to this report.

Evasions and Violations of the Law

During the first few months of the enforcement of the Federal Plant Quarantine Act a number of forms of violations or evasions of the law have come to our notice. Some of these have been due to ignorance, and some possibly have been malicious. In the main, however, it should be stated that the nurserymen and brokers have shown a keen desire to comply with the law and regulations. Many of the discrepancies noted below will probably be prevented as a result of the amendments now made to the regulations and the new form of reporting provided for. The following items under this head may be enumerated:

1. Entry by Customs Officials and Importers in Ignorance of the Law.—A few instances of this kind have come to our notice, but the amount of such violations is negligible.

The smaller or interior customs offices, which may receive imported nursery stock very rarely, may be a little difficult to keep up to the full standard of the enforcement of the Act and regulations. No difficulty will probably be experienced in any of the twenty-five or thirty principal customs ports after the regulations have once been assimilated.

2. Entry of Nursery Stock without Proper Markings or Certification.—A good many violations of this kind have come to our notice, most of them probably the result of ignorance of the law. The Department of Agriculture has no means of determining as to whether or not the regulations as to marking and certification have been complied with, except through the reports received from state inspectors, and perhaps occasional examination of goods as they are landed at one port or another. In the matter of certification, under the regulation to take effect July 1, 1913, the parent certificate of inspection must accompany the invoice, and becomes a necessary paper of entry. After the date mentioned therefore goods without certification cannot be entered, and any failure in this regard will naturally be brought to the attention of this department by the collector of customs.

We have also been advised that many of the certificates of inspection attached to packages are "New York" editions, but this sort of fraud will be stopped under the new regulations.

There has been very little difficulty in the matter of permits and consular declarations, these features being governed directly by customs officers.

3. Failure in Notifications.—There have been a good deal of omissions in the notifications required to be sent out by the person taking the goods from customs and paying the duty, namely, the notification to the Secretary of Agriculture and to the proper state inspector. Much of this failure has been occasioned by ignorance of the law on the part of the importers or brokers. The new arrangement entered into with the Treasury Department requires the importer or broker to transmit his notice to the Department of Agriculture through the collector of customs, and this notice is made a necessary paper of entry. This plan should insure in the future notification to the Department of Agriculture of every lot of nursery stock removed from a port of entry and will make it possible for the state inspector to receive notification from this department, at least, of all imported nursery stock consigned to his state, and will further be an absolute check on the notification which the broker is still required to send direct to each state inspector.

4. Interstate Distribution of Imported Nursery Stock before Inspection.—The Federal law requires that imported nursery stock shall not go into interstate transportation without a notification of such shipment being sent to the Department of Agriculture and to the proper state inspector. This applies not only to the port of entry as to first destination, but also to any reshipment, unless and until said stock has been inspected by some state inspector. There have been a number of violations of this provision. Nursery stock has been sent from the port of entry to the first consignee and properly reported both to this department and to the state inspector. This first consignee, has, however, probably in ignorance of the law, in several instances reshipped such stock to other states prior to its having been inspected without making the proper notification. This is a violation which is very difficult to prevent, and can only be checked up by the reports of such reshipments by the inspectors of the states to which the goods are sent. Discovery of such reshipments has been made by such inspectors accidentally or under local regulations requiring the reporting of arrival of all nursery stock. All instances of this kind should be promptly reported to the Department of Agriculture so that the question of violations can be taken up with the parties at fault and a continuance thereof prevented.

5. Importation of Prohibited Articles.—Violations of this kind can only be checked by state inspection. They may be accomplished by false labeling or through the ignorance of customs officials regarding prohibited plants.

6. Entry of Nursery Stock under False Designation to Escape the Requirements of Permit and Notification.—Two or three instances have come to our notice where nursery stock has been designated as bulbs or herbaceous plants, apparently to avoid by this means the requirements as to permit and subsequent notifications. Fortunately, suspicions were aroused in these instances, with the result that violations of this kind will probably not be attempted again by these particular individuals. The only means of checking up against fraud of this sort is to make occasional inspection of imported bulbs and other herbaceous plants. This duty naturally falls to the state inspectors.

In conclusion, it may be said that the control of imported nursery stock is rapidly working out in a thoroughly satisfactory manner in so far as the proper labeling and certification and other conditions of entry are concerned. The real utility of the Act, as it relates to imported nursery stock, must, however, finally depend on the character of the inspection given such stock by the several state inspectors. The Department of Agriculture will make every effort to encourage and aid the different states in getting proper legislation and funds to carry out this work of inspection. A feature which should be made a part of all state laws is the provision requiring the holding of all imported nursery stock, if possible, in original packages until the state inspector is on the ground to make his examinations. If not so held, the law should at least require that such importations, if opened up, should be heeled in or kept together in a fairly isolated place until inspection by the state official is possible.

The quarantine powers given in the Act, both foreign and domestic, are the ones which will bring the greatest protection to this country, and constitute the principal federal power of control given in the Act. Such quarantines, being entirely under federal supervision and enforced by federal officers, present no divided responsibility, and should succeed if sufficient means for their enforcement is provided by Congress.

APPENDIX: POST OFFICE ORDERS IN RELATION TO NURSERY STOCK

The following are the orders recently issued by the Post Office Department in relation to the Federal Plant Quarantine Act and the several quarantines promulgated thereunder.

TYPE OF LETTER SENT TO ALL POSTMASTERS OF OFFICES LIKELY TO RECEIVE IMPORTED NURSERY STOCK

DIVISION OF FOREIGN MAILS No. 246, 515 C. D.

Post Office Department
Second Assistant Postmaster General
Washington

November 22, 1912.

The Postmaster, New York, N. Y.

Sir: Your attention is called to the enclosed copy of a Notice to Postmasters regarding the importation in the mails of nursery stock under the provisions of "The Plant Quarantine Act" of August 20, 1912.

A copy of the rules and regulations issued by the Secretary of Agriculture for carrying out the Act in question is also enclosed herewith, together with a circular of information to importers of nursery stock issued by the Federal Horticultural Board and approved by the Secretary of Agriculture. These enclosures will enable you to carry out the provisions of the Act so far as it affects mail importations, and will also furnish you with information to answer inquiries which may be made.

Please cause due notice of the same to be taken at your office, and advise me of your having done so.

Very respectfully,
A. A. Fisher,
Acting Second Assistant Postmaster General.

Enclosures.

The notice to postmasters referred to in the above quoted letter follows:

Nursery Stock From Abroad

November 22, 1912.

Postmasters and other postal officials are informed that, under the provisions of The Plant Quarantine Act of August 20, 1912, nursery stock, which includes all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be imported into the United States only under the conditions set forth in that Act and the rules and regulations for its enforcement issued by the Secretary of Agriculture. All articles received in the mails from abroad and containing or supposed to contain nursery stock must, therefore, be submitted to customs officials for fulfilment of the formalities of entry required by the Act and in the same manner as articles whose contents are dutiable or supposed to be dutiable.

A. A. Fisher,
Acting Second Assistant Postmaster General.

TYPE OF LETTER SENT TO FOREIGN POSTAL OFFICES IN RELATION TO PARCEL POST PACKAGES FROM FOREIGN COUNTRIES OF NURSERY STOCK.

DIVISION OF FOREIGN MAILS No. 246, 467 C. D.

Post Office Department
Second Assistant Postmaster General
Washington

November 22, 1912.

The Secretary,
General Post Office, London, England.

Sir: By direction of the Postmaster General, I have the honor to enclose herewith for your information a copy of "The Plant Quarantine Act" of August 20, 1912, together with a circular of information to importers of nursery stock and rules and regulations for the enforcement of the Act, issued by the Secretary of Agriculture. You will observe that the Act provides that importers in this country must take out permits to import nursery stock as defined by the Act, and that nursery stock so imported must conform to certain stipulations concerning certification in the country of origin, labeling, and consular declaration.

The provisions of the Act and the rules and regulations for its enforcement, issued by the Secretary of Agriculture, will be applied to importations of nursery stock in the mails from foreign countries, and, consequently, will be applicable to parcel post packages, containing such stock, imported under the parcel post convention between our two countries.

Very respectfully,
A. A. Fisher,
Acting Second Assistant Postmaster General.

Enclosures.

The following order relates to the Hawaiian quarantine on account of the Mediterranean fruit fly.

ORDER OF THE POSTMASTER GENERAL

Certain Fruits, Seeds, Vegetables, and Other Plant Products Unmailable in Hawaii

Office of the Postmaster General,
Washington, Nov. 16, 1912.

Order No. 6655.

The fruits, seeds, vegetables, and other plant products, named in Quarantine Order No. 2, issued by the Secretary of Agriculture on September 28, 1912, under the authority of the Act of Aug. 20, 1912, known as The Plant Quarantine Act, are hereby declared to be unmailable in Hawaii for transmission into or through any other State, Territory, or District of the United States, so long as such order of the Secretary of Agriculture remains in force. Postmasters in Hawaii shall exercise the greatest possible care to prevent the acceptance for mailing, contrary to this order, of any of the plant products described in the order of the Secretary of Agriculture, and for this purpose shall inquire of all persons presenting parcels for mailing to any other State, Territory, or District of the United States whether they contain any of the fruits, seeds, vegetables, or other plant products declared to be unmailable.

Bananas and pineapples may be admitted to the mails in Hawaii for transmission to any other State, Territory, or District of the United States, only when accompanied with a certificate from a Territorial or Government inspector to the effect that they have been inspected and found free from the Mediterranean fruit fly.

FRANK H. HITCHCOCK,
Postmaster General.

This order is accompanied by a reprint in full of the notice of quarantine No. 2 (domestic) relating to the Mediterranean fruit fly, promulgated by the Secretary of Agriculture, September 28, 1912.

The following order relates to the gipsy and brown-tail moth quarantine:

ORDER OF THE POSTMASTER GENERAL

RESTRICTIONS ON THE MAILING OF CERTAIN TREES AND PLANTS

Office of the Postmaster General,
Washington, Nov. 27, 1912.

Order No. 6674.

Coniferous trees, or parts of trees, and decorative plants, of the area quarantined for the gipsy moth, referred to in Quarantine Order No. 4, issued by the Secretary of Agriculture, on November 13, 1912, under authority of the Act of August 20, 1912, known as the Plant Quarantine Act, may be accepted for mailing only when for transmission within such quarantined area, and when they do not exceed the limit of weight prescribed by law for fourth-class matter.

Forest plant products, field-grown plants, and plant products for propagation, of the area quarantined for the gipsy moth, and the deciduous trees or shrubs, and parts thereof, of the area quarantined for the brown-tail moth, on the movement of which restrictions are placed by the Quarantine Order of the Secretary of Agriculture, may be accepted for mailing to any point outside the quarantined area only when accompanied with a certificate of a representative of the Department of Agriculture to the effect that they have been inspected and found free from the gipsy moth and brown-tail moth, respectively, and do not exceed the limit of weight prescribed by law for fourth-class matter.

FRANK H. HITCHCOCK,
Postmaster General.

This order is accompanied by a reprint in full of quarantine No. 4 (domestic), with regulations in relation to the gypsy and brown-tail moth promulgated by the Secretary of Agriculture, November 13, 1912.

The following two orders relate to the use of the mails for the shipment of domestic nursery stock. The first of these orders (No. 6675) is an amendment of an older order (No. 6613) to bring it into conformity with the wording of the Federal Plant Quarantine Act as to definition of nursery stock. It also provides that the parcel shall be plainly marked to show the nature of the contents and the name and address of the sender. The second of these orders (No. 6696) makes it possible for the proper state official to be advised of the arrival and delivery of all mail parcels of nursery stock.

ORDER OF THE POSTMASTER GENERAL

Office of the Postmaster General,
Washington, Nov. 27, 1912.

Order No. 6675.

Paragraph 8, Section 496, Postal Laws and Regulations, is hereby amended as follows:

8. Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be admitted to the mails only when accompanied by a certificate from a State or Government inspector to the effect that the nursery from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender.

Frank H. Hitchcock,
Postmaster General.

ORDER OF THE POSTMASTER GENERAL

Office of the Postmaster General,
Washington, Dec. 4, 1912.

Order No. 6696.

Paragraph 1, Section 549, Postal Laws and Regulations, is amended as follows:

Provided, That on written request, postmasters at offices of address may furnish a State officer of any State having a law regarding the inspection of nursery stock coming into the State the names of persons to whom are addressed parcels of nursery stock received from any point without the State, marked as provided in paragraph 8, Section 496; but there shall be no delay in the delivery of such nursery stock to the addressees.

Frank H. Hitchcock,
Postmaster General.

TWO NEW COCCIDÆ

By T. D. A. Cockerell

A New Coccid from the Philippine Islands

Drosicha lichenoides n. sp. ♀. Length 12 mm. or a little over, breadth 8.5, height 5; light reddish; strongly emarginate anteriorly; smooth above, with the segmentation distinct; legs and antennæ very dark brown; antennæ about as long as anterior femur+trochanter. Microscopic characters (measurements all in microns): eyes on prominent tubercles; antennæ 9-jointed, the third joint slightly constricted before the middle, the last joint long and slender; measurements of joints (1) 240, (2) 240, (3) 336, (4 to 8) each about 320, (9) 590; femora stout; claws strongly curved, the claw digitules represented by a pair of stiff bristles, pointed toward but not reaching end of claw; greatest diameter of femur of middle leg 480; tibia of middle leg 1120 long, with about 12 short spines on inner margin; tarsus of same leg (exclud-

ing claw) 480, measured along middle line; lateral margins of insect densely beset with very short hair (about 50 long), but with occasional long slender hairs, 640 to 1120 long, these long hairs (dark in color) rather numerous at the caudal end.

Habitat, Los Banos, Philippine Is., 1912 (*C. F. Baker*). Five specimens in alcohol sent by Professor Baker, who writes that in life it is covered with thin short waxy hair-like material. It lives on the bark of *Ficus nota* (I do not find any species of this name in the Index Kewensis), "frequenting so far as I observe only areas covered with whitish lichen patches, the color of which it imitates so closely as to be very effectually hidden. It is commonly attended by ants, which lead to its discovery." Dr. W. M. Wheeler has kindly determined this ant as *Dolichoderus bituberculatus* Mayr.

By the 9-jointed antennæ, this is related to *Drosicha maskelli* (Ckll.) but in *lichenoides* the ninth joint is much longer and more slender in proportion to the basal joints. *D. corpulenta* (Kuwana) is also related, but larger, longer in proportion to its width, and has very different antennæ, the joints much shorter in proportion to their breadth (in *lichenoides* the joints beyond the second are considerably longer than broad, the seventh about twice as long as broad). The longer antennal joints also separate our species at once from *D. contrahens* Walker and *D. stebbingi* (Green); the latter has 8-jointed antennæ.

A New Coccid on Grass

Recently I had a few hours collecting at Glenwood Springs, Colorado, in the company of Mr. E. Bethel. On a species of *Agropyron* (probably *A. biflorum*) we found a mealy-bug in considerable abundance. This insect, first observed by Mr. Bethel, proves to be an undescribed *Trionymus*.

Trionymus violascens n. sp. ♀. Length nearly 2 mm., width about .75 mm.; elongated, dark plum color, appearing greyish from a scanty secretion. Very short caudal tufts of white wax, but no lateral ones. Antennæ and legs light ferruginous; legs slender; claw with no inner tooth; claw digitules extremely fine, with very small knobs. Caudal lobes hardly at all developed, each with a bristle about 140μ long. Ovisac copious, pure white, forming fluffy masses on the grass stems. Labium short, about 75μ long and 50 broad at base.

The following measurements are in microns: middle leg, femur+trochanter, 175; tibia, 125; tarsus (excluding claw) 75.

Antennal segments: (1.) 38, (2.) 38, (3.) 25, (4.) 23, (5.) 26–29, (6.) 26–30, (7.) 33–35, (8.) 70–75. The normal antennæ are 8-jointed, but one specimen has a 7-jointed antenna on one side, joint 6 of this antenna measuring 48μ. Easily distinguished from *T. nanus* Ckll. and *T. californicus* Ehrhorn, both of these being yellow or pale yellowish. *T. americanus* (Ckll.) is much larger, with a differently shaped labium. In spite of the supposed generic difference, there is much resemblance between *T. violascens* and the Californian *Ripersia festucae* Kuwana. *R. festucae* has the antennæ 7 jointed, varying to 6; the labium is considerably broader than in *T. violascens*.

ON THE FEEDING HABITS OF PIMPLA (ITOPLECTIS) CONQUISITOR SAY[1]

By F. A. Johnston, *Bureau of Entomology, U. S. Department of Agriculture.*

During recent years several instances of the feeding of hymenopterous parasites at punctures made by the ovipositor in their host have been recorded.

Dr. L. O. Howard, in an article in the Journal of Economic Entomology, Vol. 1, No. 5, 1908, describes the observations of Paul Marchal on the European *Tetrastichus xanthomelænæ*, in which he was of the opinion that in many cases the ovipositor was used to pierce the egg in order that the parasite might suck its contents. Similar observations were made on this species by Mr. W. F. Fiske when it was imported into this country.

In a circular of the Massachusetts Agricultural Experiment Station (No. 23, July, 1909) on *Tetrastichus asparagi* Crawf., Dr. H. T. Fernald mentions the fact that one of the observers of this insect at Concord, Mass., reported seeing the parasite occasionally attack the eggs with its mouthparts, consuming the contents of the egg. This same habit was noticed by Mr. C. W. Prescott of Concord, Mass., and Mr. J. B. S. Norton of the bureau of plant industry. Their observations were later verified by Mr. A. F. Burgess of this Bureau.

In an article in the Journal of Economic Entomology, Vol. 3, No. 3, June, 1910, "On the Habit with Certain Chalcidoidea of Feeding at Puncture Holes made by the Ovipositor," Dr. L. O. Howard mentions observations of Dr. Paul Marchal on the habit of *Aphelinus mytilaspidis* feeding upon its host, *Aspidiotus ostreæformis*. He also mentions that these observations of Marchal were soon followed in America by Mr. J. G. Sanders, who noticed a similar habit of *Aphelinus fuscipennis* apparently feeding on its host, *Aspidiotus rapax*.

Samuel B. Doten in Technical Bulletin No. 78, September 1911, of the Agricultural Experiment Station of the University of Nevada, describes the habits of *Meraporus* sp. and *Pteromalus puparum* feeding at punctures in chrysalides of *Pontia rapæ* and of *Microbracon juglandis* feeding at punctures in the larvæ of *Ephestia kuehniella*.

While the writer was working on truck crop insects at Riverhead, N. Y., during the season of 1912, *Pimpla* (*Itoplectis*) *conquisitor* Say came under his observation as a parasite of *Autographa brassicæ*.

On October 11 and 12 two males of this species were bred from pupæ of *A. brassicæ* and on October 30, while collecting pupæ of *A. brassicæ* in the field, a female was observed trying to oviposit in a pupa of *A.*

[1] Published by permission of the Chief of the Bureau of Entomology.

brassicæ. This appeared difficult as the pupa moved violently each time that the ovipositor touched it and the parasite did not seem to be able to pierce the pupa.

Another female was observed flying around and both were captured and taken into the laboratory.

A larva of *A. brassicæ* which had spun up but had not yet pupated was placed in a vial with one of these parasites which immediately inserted her ovipositor in it twice, the second time keeping it in the larva for 30 seconds. One oviposited in a larva which had been taken from its cocoon in 25 seconds; also one oviposited in a newly formed pupa.

An active larva was placed in one of the vials and, as the parasite crawled over it, became so violent that the parasite seemed to become frightened, leaving it immediately and not again approaching it.

A larva which had spun up but not yet pupated was next put with each parasite. After carefully examining the cocoon all over with her antennæ, the parasite in the first vial thrust her ovipositor into the larva and commenced a sort of pumping motion, working the ovipositor up and down in the larva. She kept this up for 37 seconds. At the end of that time she backed away slightly, bent her head under so as to bring her mouthparts to the puncture, and began to feed on the juices of the larva which seemed to flow quite freely from the puncture. In the meantime the tip of the ovipositor remained in the puncture. She fed in this position for 20 seconds. She then again began to work the ovipositor up and down in the same puncture. She continued this for 35 seconds and then fed for 5 minutes, this time with the ovipositor entirely withdrawn. She again started to work her ovipositor up and down in the same puncture and kept it up for 35 seconds, when she withdrew it and fed for 25 seconds, then examined the cocoon and left it.

In the other vial the parasite, after thoroughly examining the cocoon, started to feed on it as did the first. She thrust her ovipositor into the larva and worked it up and down for 3 minutes and 25 seconds, then she withdrew it and fed on the juices which came from the puncture for 1 minute and 10 seconds. She then selected a new place on the larva and, after inserting her ovipositor, worked it up and down for 20 seconds. She afterward deserted this place and returned to the first place, re-inserted her ovipositor in what appeared to be the old puncture and kept working it up and down for 1 minute and 55 seconds. After this she withdrew it and fed for 35 seconds, prodded the larva a couple of times and left it.

On the following day, October 31, one of these parasites oviposited in three spun-up larvæ and two newly-formed pupæ in succession, the

time required for oviposition being 50, 45, 40, 50, 40 seconds, respectively. She then started feeding on a newly formed pupa which was put in the vial. After inserting her ovipositor in the pupa she kept working it up and down for 1 minute and 5 seconds. She then withdrew it and fed for 40 seconds at the puncture, after which she inserted the ovipositor in the same puncture and worked it up and down for 40 seconds, when she again withdrew it and fed for 40 seconds on the juices which came from the puncture. Then she worked her ovipositor in the pupa for 20 seconds, fed for 25 seconds, worked for 5 seconds and fed for 10 seconds more. She then examined the pupa and left it.

A few hours later this same parasite oviposited in 5 pupæ in 1 minute, 10 seconds; 1 minute; 45 seconds; 40 seconds; 2 minutes, 5 seconds; respectively. The other parasite during the day parasitized two spun-up larvæ and 5 pupae without feeding on any, the time required being 1 minute; 50 seconds; 35 seconds; 1 minute, 35 seconds; 40 seconds; 5 minutes, 45 seconds; 2 minutes, 45 seconds.

On November 1 one oviposited in a pupa in 2 minutes and 5 seconds. A pupa was then left in the vial for a few hours and when again examined showed that the parasite had fed on it. She immediately parasitized a fresh pupa placed in the vial, taking 1 minute and 45 seconds to complete the oviposition.

A fresh pupa was put in and the parasite started feeding on it. After making a thorough examination she thrust her ovipositor into the pupa and kept working it up and down, as in previous instances, for 1 minute and 15 seconds, after which it was withdrawn and she fed at the puncture for 30 seconds, afterward again inserting the ovipositor in the same puncture and working it up and down for 45 seconds. Then she withdrew it and fed for 30 seconds; worked for 45 seconds, fed for 30 seconds, worked for 35 seconds, fed for 20 seconds, then she went to a new place on the pupa and inserted her ovipositor and kept working it up and down for 1 minute and 40 seconds, then she fed for 35 seconds, worked 45 seconds and fed for 30 seconds. She then examined the pupa and left it.

During the day 6 pupæ had been placed in the vial with the other parasite and she was observed to oviposit in all of them but feed on none. This parasite died during the next 3 or 4 days, which were quite cold, and the other parasite showed little activity. However, on the morning of November 6 it was noticed that she had fed on a pupa which had been left in the vial over night. A spun-up larva was placed in the vial and she oviposited in it in 1 minute and 25 seconds. When she withdrew her ovipositor she placed her mouth parts to the puncture and fed a few seconds. This seemed to stimulate a desire to feed, for she immediately attacked the larva in a new spot and, after insert-

ing the ovipositor, she kept working it up and down for 40 seconds, and then she fed at this puncture for 1 minute and 30 seconds, when she left the larva. After feeding on this larva she parasitized 4 pupæ.

On the following day she fed on another spun-up larva, working the ovipositor up and down in the larva for 2 minutes, fed for 1 minute and 15 seconds; worked for 1 minute and 35 seconds; fed for 1 minute and 10 seconds; worked for 35 seconds; fed for 3 minutes and 30 seconds; and then left it.

On November 8 a pupa that had been left over night in the vial with the parasite had been fed on. After parasitizing two pupæ she fed on the third one that was put in the vial. She worked her ovipositor up and down in the pupa for 2 minutes and 45 seconds, then fed for 1 minute and 40 seconds and then left it. This parasite was destroyed by a mouse on the following night.

On November 8 four more females of this species were taken in the field and brought into the insectary. Three of them were very small and appeared weak and after trying for 9 or 10 minutes to oviposit in a pupa, they usually left it. They only lived for a day or two in the insectary. The fourth one was nearer normal size and during the five days she lived she parasitized 9 and fed on 2 pupae.

The last pupa that this parasite parasitized was on November 13 and after puncturing the pupa with her ovipositor she kept it in the pupa for over 14 minutes before she oviposited. On this date she appeared quite sluggish, as if about ready to die, and on the following morning was found dead.

IMAGINATION AND FACTS

Imagination is of great service to the scientific man. The formulation of important hypotheses has depended in large measure on the judicious exercise of this faculty. We present below a reprint of a leaflet forwarded through the courtesy of a collaborator and showing the results of allowing imagination free reign—cerebration unembarrassed by facts. The scientific attitude toward spontaneous generation, if suspected in the slightest degree by the writer, is cheerfully ignored. The fundamental biological law, like produces like, is suspended. Nature is depicted as creating an organism destined to perish without providing for the perpetuity of the species. The succession of stages observed in so many insects is disregarded. Our friend sees no advantage in food stored in the seed.

COW PEA WEEVILS

These germinate inside the pea itself, they do not, as many think, come from an egg laid on the outside of the seed by some insect.

The cause of this weevil is the pea getting hot, from hot weather, sufficient to make the weevils hatch.

When the weevil emerges from the pea his life is ended and he dies in a few hours; should the peas remain hot, weevils will continue to hatch out until the peas are riddled.

These weevils do not go to anything else, nor lay any eggs from which any other insect hatch.

Some seed men are afraid to put peas into their houses that show weevils for fear these weevils will ruin everything in their houses, which is absurd.

Peas are not hurt for planting purposes by being weevil bored, even when riddled by holes they will germinate as it is the eye of the pea, like the eye of the potato which gives out the sprout.

Some large planters in the South hunt for weevil bored peas which can be bought at a little reduction, knowing they are just as good for planting as sound peas and have more seed to the bushel, when bought by weight.

The above is only a fair sample of what might be termed "commercialized science" as expounded by ignorant or irresponsible parties presumably more interested in immediate profit than in developing a substantial business. Fortunately, such literature is commendably rare in this country. The more reputable dealers, we are happy to state, are coming into closer relation with scientific men and are, as a rule, most desirious of learning the latest developments. This latter is as it should be, since material progress is impossible without a thorough understanding of the fundamentals involved.

ENTOMOLOGICAL CONFERENCES IN PORTO RICO

During the past two years a great impetus has been given to work along the lines of economic entomology in Porto Rico. The establishment of the Experiment Station by the Porto Rico Sugar Producers Association at Rio Piedras was followed by the organization of an Insular Board of Commissioners of Agriculture and somewhat later the College of Agriculture was established at Mayaguez where the U. S. Agricultural Experiment Station has been in progress for a number of years. These institutions employ seven trained entomologists while work along the line of insect control is carried on by Guánica Centrale and the Fajardo Sugar Company. It seemed wise for these men to confer regarding their various lines of work and, after discussing the matter, a meeting was called at Rio Piedras May 25th, 1912, by Mr. D. L. Van Dine, Chairman of the Conference. The various lines of investigation were outlined, methods of work discussed and lists of entomological literature exchanged. Mr. C. W. Hooker was chosen Chairman in charge of program and meeting for the second conference to be held at the Agricultural Experiment Station in Mayaguez some time in November, 1912.

The second meeting of the Entomologists of Porto Rico was held at the U. S. Agricultural Experiment Station at Mayaguez, P. R., Nov. 26, 1912. The meeting was called to order by C. W. Hooker at 9.45 a. m. and the following papers read and discussed:

1. D. L. Van Dine: Entomologist of Sugar, Expt. Station, Rio Piedras: May-Beetles of Porto Rico.

   There are at least six species of May-beetles in Porto Rico where we expected only three or four at the most. Determination is difficult and only possible with a long series of alcoholic or properly dissected and mounted specimens, hence it will be a long time before we can distinguish the different species or their larvæ with any certainty.

2. W. V. Tower: Entomologist, Board of Agriculture, San Juan: Quarantine Work: (read by Mr. Crossman).

   A history of the Plant Quarantine legislation enacted and that proposed to exclude the Mediterranean fruit-fly which would ruin the insular citrus business. Careful watch is necessary to exclude injurious insects and diseases.

The meeting adjourned at 11.30 a. m. for lunch and reassembled at 1.30 p. m.

3. T. H. Jones: Assistant Entomologist, Sugar Experiment Station, Rio Piedras: The Sugar-cane Aphis and its Natural Enemies.

   The sugar-cane aphis (*Sipha graminis* Klt.) feeds only on the under surfaces of the older leaves which are bent at an angle of 45 degrees or more from a vertical position, possibly because they are better protected from rain and sun. They are attacked by four native ladybirds—*Cycloneda sanguinea* L., *Megilla innotata* Vauls., *Scymnus loewii* Muls., and *Scymnus resecollis* Muls?,—a Syrphid fly, a Chrysopid or Lacewing fly and a fungus.

4. R. C. McConnie: Fajardo Sugar Co., Fajardo: A fungus parasite (Aspergillus sp.) of the Sugar-cane Mealy-bug.

   This fungus is apparently scattered all over the island and is doing good work in damp localities; hence should be very effective in irrigated fields. Mr. Garrett mentions it as doing good work in Louisiana cane fields.

5. C. T. Murphy: Guanica Centrale, Ensenda: Sugar-cane Insects Work at Guanica.

   A systematic fight against the sugar-cane insects has been carried on at Guanica for some years. The best results have been attained by hand picking grubs and adult caculos, and plowing up the stools for hogs to root and poultry or birds to scratch. The adults are most abundant during May and June, sometimes again in August. The average number of grubs per stool has been reduced from thirty to forty in 1909 to eleven or twelve in 1912. Fifty quarts per night were sometimes taken. Burning the trash while fresh and selecting seed is necessary to combat the other cane insects.

6. S. S. Crossman: Asst. Ent. Board of Agriculture, San Juan: La Changa:

   A sketch of the literature on the Changa, its habits and progress of work against it.

7. R. I. Smith: Entomologist, College of Agriculture, Mayaguez: Entomology at the College of Agriculture:

   A sketch of the proposed work in entomology at the College of Agriculture.

8. C. F. Kinman: Horticulturist, Agr. Expt. Station, Mayaguez: Survey of the Insular insects and need of Insect Work.

   A summary of the citrus growers reports on the distribution, habits and methods of control of the Caculos.

9. C. W. Hooker: Entomologist Agr. Expt. Station, Mayaguez, Coffee Insects.

   General summary of the coffee insects of Porto Rico; Coffee ant (*Myrmelachista ambigua ramulorum* Wheeler), Leaf miner (*Leucoptera coffeella* Niet.); Weevil; Borer; Fulgorid; Spittle Insect; Cricket (*Gryllodes muticus?*) Scale, Aphis, Thrips, Fleabeetle, Hemisphaerical scale, etc.

Sr. Don Agustin Navarrete (Secretary of Porto Rico Sugar Growers Association) who was to have presented a paper on Early References to Porto Rican Entomology, owing to sickness could not be present but sent his regrets and best wishes.

After these papers were read and discussed a business session followed and plans were laid for a more general Agricultural meeting at San Juan in May, 1913.

After an exhibition of specimens and literature on Porto Rican insects, lists of named specimens and literature in the various institutions were exchanged.

C. W. Hooker,
Secretary.

THE FIFTIETH ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO

In 1863 the Canadian Entomological Society was founded but next year the same Society, under another name but similar in its objects and constitution, will celebrate its fiftieth anniversary. The name was changed in 1871 when the Government of the Province of Ontario passed a statute incorporating the Society as the Entomological Society of Ontario and gave it a grant. Though provincial in name it has retained its larger character and has branches not only in Toronto but also in Montreal and British Columbia. At the annual meeting held on November 19 and 20, 1912, at Ottawa, it was decided to have a special jubilee celebration in 1913, probably in September and to invite kindred societies in North America to send delegates to the meeting which will be held at the Ontario Agricultural College, Guelph, Ont., one of the oldest agricultural colleges on the continent over the Entomological Department of which Dr. C. J. S. Bethune, the veteran Canadian entomologist has charge. The founders of the Canadian Entomological Society were Dr. C. J. S. Bethune, Dr. William Saunders, late director of the Dominion Experimental Farms and Mr. Baynes Reid. Happily all three are still able to take an interest in the Society. Doctor Bethune was the first president of the Society and until two years ago was the editor of the Society's journal, *The Canadian Entomologist.* The Society is fortunate, therefore, in being able to honor, as it did at its recent annual meeting, Doctor Bethune, by electing him president of the Society in its jubilee year. Further particulars in regard to the meeting will be published at a later date. The members of the Society are looking forward to having the pleasure of the company of many of their entomological friends and co-workers from the United States on that occasion.

C. G. H.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

Reprints will be supplied authors at the following rates:

Number of pages	4	8	12	16	32
Price per hundred	$1.50	$3.50	$4,25	$4.75	$9.00
Additional hundreds	.25	.50	.75	.75	1.50

Covers, suitably printed on first page only, 100 copies, $2.00, additional hundreds, $.50. Plates inserted, $.50 per hundred. Folio reprints (50 only) $.50. Carriage charges extra in all cases.

In view of the recent discoveries in medical entomology, many of which were made by economic entomologists, it is gratifying to know that other professions are recognizing the importance of those sanitary precautions which from his knowledge of the subject, the economic entomologist deems essential. In the *Proceedings of the American Society of Civil Engineers* Vol. XXXVIII, No. 9, issued in November, 1912, there is a short paper (page 1567) on "Prevention of Mosquito Breeding" by Mr. Spencer Miller, and (page 1575) an admirable illustrated paper on "The Sanitation of Construction Camps" by Mr. Harold Farnsworth Gray. The latter paper deals with the fly and mosquito problems and treats particularly of the disposal of waste. As much of the construction work is in charge of civil engineers, articles of this character are certain to be productive of salutary results.

W. E. B.

The admission of the Apiary and Horticultural Inspectors Associations as sections of the Society means separate meetings in these two subjects and is a natural introduction to other sectional divisions. This action does not necessarily imply any lowering of membership standards. There has been a great broadening in the field of economic entomology during the past decade and there is no reason to think that the process has reached its limit. The recognition of this and the adaptation of the program to the pressing and diversified needs of our increasing membership will result in more successful meetings and a stronger association. Our aim should be to provide facilities for the satisfactory discussion of any phase of economic entomology at each meeting and to arrange for the speedy publication of the Proceedings. The imposition of time limits at our gatherings, though sometimes necessary, is unsatisfactory, since arbitrary rules may pre-

vent the proper consideration of extremely important subjects as well as to assist in eliminating the irrelevant and comparatively unimportant. The judicious summary and the general recognition of inevitable limitations have done much to promote a free exchange of views and have made our sessions correspondingly valuable for all who could attend.

The value of a figure or illustration may be somewhat accurately gauged by its life—the period during which it is used in current publications. The earliest illustrations of insects in American works were relatively crude. Riley, with his great facility for depicting natural objects, established a distinctly higher grade forty years ago. His work has given way in current prints largely to more detailed figures or the more recent process illustrations with their pleasing softness of outline. Illustrations, whether pencil, ink, photographic or colored, which can not be bettered in their respective classes, are valuable additions to literature and science. This is a standard we advocate for artists and those responsible for their work. A few really excellent figures are decidedly preferable. These are the kind which will continue to live and be reproduced for half a century or more. Let us, when drawing, painting or photographing, work for the good of posterity as well as for immediate results.

Reviews

Some Scale Insects of Mississippi with notes on certain species from Texas, by Glenn W. Herrick. Technical Bulletin No. 2, Mississippi Agricultural Experiment Station, Agricultural College, Miss., 43 pages of text and XXXIII plates with index, 1911.

This publication gives directions for collecting, preparing and mounting scale insects. Then follows an alphabetical list of 48 species giving food plants and distribution. All but seven of the species listed occur in Mississippi and the others were collected in Texas and Louisiana. Following the list and arranged in the same order are descriptions of the scales of both sexes and of the pygidium of the female, of each species. The illustrations do not appear with the descriptions but are placed by themselves following the text. References to them appear in the descriptions and a reference to the original description of each species is also given. The pygidial characters of about 34 of the 48 species listed are shown on the plates, made from pen drawings by the author.

This publication though bearing the date of February, 1911, was not distributed until late in the year of 1912.

This bulletin is certain to prove helpful to students of the family Coccidæ, and though the insects are not treated from an economic standpoint, the publication should be in the library of every economic entomologist.

W. E. B.

Injurious Insects: How to Recognize and Control them. By WALTER C. O'KANE, 414 pages, 606 figures. The MacMillan Company, New York. $2.00 Net.

Professor O'Kane and his publishers are to be congratulated on producing an attractive book which is bound to be useful to the common people who have no particular knowledge of insect life. On the whole the subjects are well chosen, and particular attention is paid to the appearance of the injury caused by each pest. This volume differs notably from most works of its kind in two respects, viz.: (1) the insects are arranged neither from the standpoint of their relationships, nor from that of their chief food plants: (2) it is illustrated wholly by original photographs. As to the first the author states in the preface that he hopes "to avoid as far as possible the duplication inevitable where one attempts to group pests according to their host plants." The pests are grouped as follows: Attacking the roots of plants: boring in the stem and branches: feeding on the outside of the stem: leaf feeders: attacking flowers and fruit.

Though this arrangement avoids duplication, it is often an advantage to have the chief insect pests listed for each crop.

As to the illustrations, the best ones are excellent and it is to be regretted that this standard could not have prevailed throughout the book. The present writer is fully aware of the difficulty of obtaining at the desired moment the material necessary to show the life stages and work of insect pests. Yet in adhering strictly to the rule of originality, the author has used a number of photographs which do not make recognizable the insect in question. Had these been supplanted by the best photographs to be obtained from other workers, the book might have presented a still better appearance, if less original. The present writer is not yet convinced that photographs are in all cases preferable to good drawings especially to show structural characters; but when used great care must be taken to have the material in perfect condition and properly prepared. For instance, the sawflies shown in figures 419, 420, 422, and 426 have their wings crumpled and hardly add to the value of the book, though they detract from its appearance. Some other figures show poor material, and many good specimens had their wings, legs or antennæ carelessly set. The small natural sized figure shown beside the enlarged one is distinctly preferable to the usual hair line indicating size.

Pages 1 to 51 are devoted to a brief account of the injury caused by insects, their structure, senses, behavior, transformations, classification, natural enemies, how they spread, and how they carry disease. Pages 55 to 104 treat of methods of controlling insects, including mechanical means and the use of insecticides. The principal types of pumps, nozzles and other accessories are figured and described. Pages 107 to 379 describe the injury to crops by the various species of insects. It is divided into three chapters as follows: Insect Pests of Garden and Field Crops; Insect Pests of Orchard and Small Fruits; and Insect Pests of the Household and Stored Products. Insects attacking shade trees, except as they are pests of fruit trees are not included. Pages 381 to 389 contain an alphabetical list of the scientific names of the insects considered in the text; for each species, one reference is given where the reader may find a more comprehensive or detailed account if desired. The pages of the text are entirely free from references of this sort. A good index fills pages 391 to 414.

Under the heading "House Ants," page 351, one could wish that so simple and effective a remedy as naphthalene flakes scattered around the edges of the shelves or corners of the room, had not been omitted.

Notwithstanding these few criticisms, the book will doubtless fill a popular demand and should be recommended. The book is well written, and the text and illustrations are printed in such a manner as to give the volume an attractive appearance.

W. E. B.

Current Notes

Conducted by the Associate Editor

Mr. Lawson Caesar has recently been appointed Provincial Entomologist of Ontario.

Mr. Peter Cameron, author of "British Phytophagous Hymenoptera" died December 1st, 1912.

Ray Painter has been appointed assistant in entomology at the Oklahoma College and Station.

The new $100,000 building of the Wyoming College and Station will contain an entomological laboratory.

Dr. L. O. Howard lectured before the undergraduates at Oberlin College, January 7, on certain types of noxious and beneficial insects.

Mr. Henry H. Severin, recently of the College of Hawaii, is an Honorary Fellow at the University of Wisconsin.

Forest Insect Field Station number 5, of the Bureau of Entomology has been removed from Yreka to Placerville, California.

The recent death of Mr. W. G. Wright, a well known lepidopterist of San Bernardino, Cal., and author of "Butterflies of the West Coast of the United States" has been announced.

Two new ports of entry for horticultural inspection have recently been established on the Pacific coast,—San Francisco and Seattle.

Mr. R. W. Braucher is Principal of the Davey Institute of Tree Surgery, Kent, Ohio, from December 1st to April 1st, 1913.

Mr. F. A. Huntley, horticultural inspector for the State of Washington, has been appointed United States inspector for the port of Seattle.

The late Frederick Blanchard bequeathed his entomological collection to the Museum of Comparative Zoölogy of Harvard University.

Mr. William F. Kirby of the Zoölogical department of the British Museum and author of entomological papers died on November 20, 1912, at the age of sixty-eight.

Mr. George H. Hollister, a member of this association, has been made Superintendent of Keney Park, Hartford, Conn. His new duties were assumed January 1st, 1913.

Mr. A. G. Ruggles, of Minnesota, who at present is on leave of absence and entomologist for the Pennsylvania Chestnut Tree Disease Commission, spent Christmas at his home in Nova Scotia, and on his return stopped at New Haven and New York.

The Paris Academy of Sciences has awarded prizes of $500 to Dr. Carlos J. Finlay and Dr. A. Agramonte, of Havana, for their work on the rôle of the mosquito in the transmission of yellow fever.

Prof. C. F. Hodge of Clark University, Worcester, Mass., gave an address before the Science Club of the University of Wisconsin, November 6, 1912. His subject was "Fly Extermination as a Problem in University Biology."

Members of the Federal Horticultural Board were present at the meetings of the American Association of Horticultural Inspectors at Cleveland, Ohio, the first week of January.

Mr. M. P. Somes, formerly assistant to the State Entomologist of Minnesota, has recently been appointed Assistant Professor of Entomology at Clemson College, S. C.

Mr. Arthur M. Lea, formerly of the Department of Agriculture at Hobart, Tasmania, is now Entomologist of the museum at Adelaide, South Australia.

According to *Science*, Major Sir Ronald Ross, professor of tropical Sanitation in the University of Liverpool, has been appointed physician for tropical diseases in King's College Hospital, and will commence his duties next autumn after the removal of the hospital to Denmark Hill.

The American Association of Horticultural Inspectors and the American Association of Apiary Inspectors will hereafter be affiliated with the American Association of Economic Entomology, and will hold their meetings as sections of that association. This matter has been under consideration for some time and final action was taken at the recent meetings at Cleveland.

Dr. E. F. Phillips in charge of bee culture of the Bureau of Entomology, is conducting some apicultural investigations this winter at the University of Pennsylvania, Philadelphia.

Prof. Wilmon Newell, College Station, Texas, was thrown from a carriage in November and badly injured his ankle. He discarded his crutches on starting for the meetings at Cleveland.

The following item appeared in *American Fruits:* "Albert B. Scammel for the past six years county horticulturist of Mesa County, Colo., has resigned, and will go to Atlantic City, N. J., to take up the study of insect problems under the United States Bureau of Entomology.

According to *Science* a national and international testimonial is planned for Dr. Patrick Manson on the occasion of his retirement in recognition of his work in tropical medicine. A portrait and perhaps a scholarship in tropical medicine has been suggested for the national and a gold medallion for the international testimonials.

Mr. D. M. Rogers now has charge of the Federal Quarantine Inspection Service in the gypsy and brown-tail moth section of New England. All scouting and control work west of Worcester and Providence has been placed in charge of Mr. L. H. Worthley.

The State Beekeepers Association of Massachusetts was formed at Worcester, September 14, and provisional officers were elected as follows: President, John L. Byard; Vice-President, J. B. Levens; Secretary-Treasurer, Burton N. Gates.

Mr. Harrison E. Smith of the Gypsy Moth parasite laboratory has been transferred to the Cereal and Forage Crop Insect Investigations of the Bureau of Entomology and is now located at the laboratory at Wellington, Kans.

Mr. Harry S. Smith of the Bureau of Entomology, recently engaged in alfalfa weevil investigations at Salt Lake City, Utah, has accepted a position in charge of the insectary of the State Commission of Horticulture, Sacramento, Cal.

Dr. William A. Buckhout, Professor of Botany and Horticulture in Pennsylvania State College, died December 3, 1912, aged 66 years. He was the author of a number of articles on economic entomology, published in journals and in reports of the State Board of Agriculture and of the Pennsylvania Agricultural Experiment Station.

According to *Science* Dr. L. O. Howard acted as toastmaster at a complimentary dinner given December 13th at the Cosmos Club to Dr. Theodore N. Gill, "in com-

memoration of the seventy-fifth year of his life and of the fifty-fifth year of his publishing activities as a naturalist." More than one hundred attended.

Mr. J. F. Illingworth of the Davey School of Tree Surgery, began his work January 1, 1913, as Professor of Entomology in the University of Hawaii at Honolulu. Mr. Illingworth was formerly at Cornell University where he investigated the apple and cherry maggots. The results of these studies will soon appear in bulletins of the Cornell Station.

According to *Science* Professor "Edgar M. Ledyard who spent the past year at the University of Michigan where he put the entomological collection in order and left some sixty thousand Philippine insects, has returned to his work as assistant professor in entomology" in the University of the Phillippines.

Prof. P. F. Williams, State Horticulturist of Alabama, died of tuberculosis at Ashville, N. C., December 4, 1912. Professor Williams was born at Natick, Mass., September 15, 1883, was graduated from the Massachusetts Agricultural College in 1905, and in 1908 assumed the duties of assistant horticulturist at the Alabama Station. Upon the resignation of R. S. Mackintosh in 1910, Williams was appointed State Horticulturist, Professor of horticulture, and head of the department in the college and station. He had charge of the nursery inspection work. A widow and two young children survive him.

At the recent meeting of the Entomological Society of America, held at Cleveland, December 31 and January 1, the following officers were elected:

President, Prof. C. J. S. Bethune, Ontario Agricultural College, Guelph, Ont.
First Vice-President, Prof. Philip P. Calvert, University of Pennsylvania.
Second Vice-President, Prof. W. M. Marshall, University of Wisconsin.
Secretary-Treasurer, Doctor Alex. D. MacGillivray, University of Illinois.
Additional members of Executive Committee:
Prof. Herbert Osborn, Ohio State University.
Prof. V. L. Kellogg, Stanford University.
Dr. J. G. Needham, Cornell University.
C. T. Brues, Bussey Institute, Harvard University.
Nathan Banks, U. S. National Museum.
Prof. C. P. Gillette, Director Colorado Agricultural Experiment Station.
Member of Committee on Nomenclature:
E. P. Felt, New York State Entomologist.

The annual address was given Wednesday evening, January 1, on "An Entomologist in Costa Rica" and was illustrated with lantern slides.

FEDERAL QUARANTINE NOTICE

Mexican fruit fly (*Trypeta ludens*). Under authority of the Plant Quarantine Act, the Secretary of Agriculture, Hon. James Wilson has declared a quarantine against this insect and forbids the importation into the United States from the Republic of Mexico, of the following fruits or their horticultural varieties: Oranges, sweet limes, mangoes, Achras sapotes, peaches, guavas and plums.

Mailed February 25, 1913.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS.
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD, Wooster, Ohio.

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Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
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OF

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Vol. 6 APRIL, 1913 No. 2

Proceedings of the Twenty-fifth Annual Meeting of the American Association of Economic Entomologists

(*Continued from page 112*)

President W. D. Hunter: The next paper will be by Mr. W. J. Schoene on "Notes on Comparative Tests with Zinc Arsenite and Arsenate of Lead."

NOTES ON COMPARATIVE TESTS WITH ZINC ARSENITE AND ARSENATE OF LEAD

By W. J. Schoene

The statement has been made that in proportion to its arsenical content zinc arsenite is more toxic to insects than arsenate of lead. In order to determine this point feeding tests were arranged to secure more data regarding the comparative efficiency of these poisons. At the same time experiments were made to determine the effect of zinc arsenite on foliage.

Most of the feeding tests were made in the laboratory, the foliage being usually sprayed with an aspirator. Sometimes leaves were taken from especially treated trees in the field. Arsenate of lead and zinc arsenite were used singly and in combination with bordeaux, lime-sulphur, molasses, glucose, soap, glue and lime. One sample of lead arsenate paste was taken as a standard for comparison and the poisons were used at the rate of 3 pounds of lead or 1 pound of zinc to 50 gallons of spray. The lead contained 17.75 per cent arsenic oxide and the zinc 40.28 per cent arsenious oxide. To ascertain its safeness to foliage zinc arsenite was applied to apple, pear, peach, elm, willow, cabbage and potato. The insects employed in the feeding tests were the spiny-elm caterpillar (*Euvanessa antiopa* L.), fall web-

worm (*Hyphantria cunea* Dru.), zebra caterpillar (*Mamestra picta* Harris), and willow beetle (*Lina scripta* Fab.). This paper deals with the effects of these compounds on the insects and on apple foliage.

The results of the feeding tests are briefly summarized as follows:

(1) The most striking difference in the action of the poisons was noted in several experiments when the caterpillars were on the tree at the time of treatment or placed on the foliage while it was wet with the spray. Under these conditions the zinc had double the speed, as compared with the lead poison. This difference was not so noticeable with larvæ of the willow beetle.

(2) In all of the other feeding tests there were no important differences regarding speed of action in favor of either poison. The results varied but the zinc combinations were slightly quicker in most experiments.

(3) Likewise there was no great difference in the sticking properties of these poisons. The adhesive quality was very well shown in some tests in which the sprayed foliage was subject to the action of the weather for periods of 3 days, 8 days and 24 days. The conspicuous result of these latter experiments is that, both when first applied and when subject to weather action, zinc arsenite or arsenate of lead used alone were equal in effectiveness.

(4) All the combinations were at first more or less repellent, but when exposed to the weather the poisons in question, either singly or with lime-sulphur, soon lost this quality and became more attractive to the caterpillars; while with combinations containing bordeaux and soap there was only a slight loss in the repellent properties during the experiment. With most of the combinations a reduction in efficiency was coincident with the loss of the distastefulness of sprayed foliage.

In our spraying experiments zinc arsenite did not injure apple foliage when used with lime or with bordeaux mixture. There was slight marginal injury in one experiment with lime-sulphur. In all of the other tests where zinc was used alone or in combination with soap or glucose there was more or less browning of the margins of the leaves with crescentic rings about ruptured areas in the epidermis.

President W. D. Hunter: This paper is before the Association for discussion.

A. W. Morrill: I have been especially interested in arsenite of zinc during the past season in connection with the control of the bean lady bug. The foliage of the bean appears to be unusually susceptible to injury by arsenical insecticides. Our experiments so far are not conclusive, but the brands of zinc arsenite so far tested on the bean have been a little more injurious than arsenate of lead.

Apparently different lots prepared by the same manufacturers differ considerably in regard to injuriousness to plants. The "Ortho" brand arsenite of zinc is now recommended by the manufacturers to be used with equal parts of commercial iron sulphide. This is said to neutralize the injurious effects.

President W. D. Hunter: Any further discussion. The chairman believes that Dr. Ball is not present. The next paper is by W. C. O'Kane, on "Arsenical Residues on Fruit."

ARSENICAL RESIDUES ON FRUIT

By W. C. O'Kane, *Durham, N. H.*

(Withdrawn for publication elsewhere.)

President W. D. Hunter: Any discussion on this paper?

Mr. E. P. Felt: I was interested in the paper because for some years questions have been coming to me along that line. We all know that the amount of arsenate of lead used for spraying shade trees has been increased. Our experiments show that arsenate of lead remains on the trees some time. I believe in using poisons, and even after hearing the evidence, we should all be careful and not advise the use of too much.

Mr. C. L. Marlatt: I would like to inquire as to the cumulative effects of arsenate of lead.

Dr. Hall: In reply to this question I will say as a physician, and not as an entomologist, that arsenic is a drug that one can get a tolerance for. Small quantities act as a tonic and the amount that can be taken without showing any serious effects can be increased from time to time.

Mr. R. W. Braucher: In regard to animals being injured by lead poisoning, I will say that in an orchard where I worked last summer one cow was killed and two made sick. Investigation showed that the trouble was not caused from spraying but was due to the animals licking the dry residue on the inside of some of the barrels which had contained lead and which were carelessly placed on a dump in the pasture.

Mr. A. F. Burgess: I would like to make one suggestion in regard to the results of experiments given in the paper by Mr. O'Kane. You will note that the spraying was carried on in August shortly after the small brown-tail caterpillars had hatched. Such spraying of course, leaves a heavy residue on the foliage and fruit, but it is not necessary to spray at this season of the year except in regions where the brown-tail moth exists. In nearly all the orchard sections

of the United States it would not be necessary or desirable to spray with poison so late in the season and this being the case the poison which would remain on the fruit from ordinary spraying, would be much less than the amounts recorded in the paper presented.

President W. D. Hunter: The next paper will be by Mr. G. D. Shafer on, "How Contact Insecticides Kill."

HOW CONTACT INSECTICIDES KILL

By G. D. Shafer, *Lansing, Mich.*

(Withdrawn for publication elsehere.)

President W. D. Hunter: As the amount of time remaining is very limited it has been suggested that Dr. Felt's paper be read and discussed and that the remaining papers be placed on the program for the next session. If there is no objection we now will listen to the paper by Dr. Felt, entitled, "Injuries Following the Application of Petroleum and Petroleum Products to Dormant Trees."

INJURIES FOLLOWING THE APPLICATION OF PETROLEUM OR PETROLEUM PRODUCTS TO DORMANT TREES

(Abstract)

By E. P. Felt, *Albany, N. Y.*

Attention was called in a summary manner to earlier injuries in New York state by petroleum or mechanical emulsions of the same. More recent damage following the application of miscible oils to hard maples and apple trees was briefly described. The conclusions reached were as follows:

The use of oils or oil preparations on dormant trees has been followed in several cases by severe injury.

Trees, as living organisms, respond to climatic and cultural conditions and, as a consequence, their power of resisting penetration and injury by oils undoubtedly varies with the season and probably from year to year.

Since certain weather conditions promote injury by oils, it appears impossible to be certain that deleterious effects may not follow spraying trees with an oil or oil preparation.

Fall treatment with an oil appears to be more hazardous than spring applications.

Other things being equal, we believe there is less danger of penetration by oil and a consequent injury if the applications are made

in the spring shortly before active growth begins, and presumably offers greater obstacles to entrance by oil or quickly replaces destroyed and necessary vital tissues.

PRESIDENT W. D. HUNTER: This paper is now open for discussion.

[The following has been supplied by Mr. Yothers as a substitute for his remarks. Ed.]

THE EFFECTS OF OIL INSECTICIDES ON CITRUS TREES AND FRUITS[1]

By W. W. YOTHERS, *Bureau of Entomology*

The effect on citrus trees and fruits of those commercial and home-made insecticides having a mineral oil base is of primary importance. This is especially the case since these are the only kinds of insecticides which have been found up to this time to be effective in controlling the white-flies, and the grower who desires to spray has no alternative. Their effectiveness against scale insects and rust mites also increases the importance of this subject.

As a general proposition their use is attended with little, if any, danger to the trees or fruit. On the other hand, the killing of the insects results in great benefit to the tree. There are certain chemicals, however, which usually cause damage when applied to the trees in the form of a spray and there are certain practices which should be followed in the use of oil sprays on citrus trees.

The use of sulphuric acid in a spray should be avoided. One brand of commercial miscible oil contained $2\frac{1}{2}$ per cent of sulphuric acid according to the analysis of the Bureau of Chemistry. Dozens of tests were made with this insecticide and every one resulted in some form of injury. When used at a strength of $1\frac{1}{2}$ per cent of oil or 1 part of insecticide to about 55 parts of water in the winter, a large part of the leaves fell and holes were burned in others that remained on the trees. So far as observed no twigs were killed. It is very doubtful, however, if this in the least made the following crop of fruit less. When used in April when the oranges were about $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, at 1 per cent of the oil contents the new leaves were injured and many new and old leaves fell. About three fourths of the crop of fruit fell or was so badly scarred as to be unsalable. When used in April at $\frac{1}{2}$ of 1 per cent of the oil contents or about 1 part of insecticide to 170 parts of water, it burned holes in the new leaves, and the results even at this weak dilution were so disastrous as to prevent

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[1] Published by permission of the Chief of the Bureau of Entomology.

its use. Since it requires a dilution of spraying material containing approximately 1 per cent of oil to be effective against the insects further experiments were discontinued. According to our observations this acid did not increase the insecticidal qualities of the spray. We were unable to test sulphuric acid in any of the formulæ since it always prevented the emulsification of the oil by the soap.

The use of rosin or rosin oil should also be avoided. One brand of commercial miscible oil contained a considerable percentage of rosin oil and this, while not so injurious as sulphuric acid, burned the leaves and fruit when used at 1 per cent of the oil contents. The use of rosin oil in the home-made products always resulted either in great damage or unfavorably. One sixth of 1 per cent used in a spray containing 2 per cent of oil caused many more leaves to fall than where the same amount of oil in a spray without the rosin oil was used. When used in May on oranges $1\frac{1}{2}$ inches in diameter at 1 quart rosin oil to the emulsion required to make $\frac{1}{2}$ of 1 per cent of petroleum fuel oil for 200 gallons of water or $\frac{1}{8}$ of 1 per cent of rosin oil, large areas were scarred. This injury was usually found on the lower part of the orange where the drop of spray had collected. Rosin oil did not increase the insecticidal qualities as much as it was expected and since it costs about three times as much as the paraffine oil, we strongly advise against its use.

Experiments with another miscible oil, made on the same dates and in the same groves, using exactly the same percentages of oil as was used in the experiments with the above brands, gave only good results. It did not burn the leaves nor fruit and did not cause an excessive shedding of leaves in the winter. The analysis showed this product to be free from sulphuric acid and rosin oil, and to contain only such chemicals as were necessary for the proper emulsification of the oil used in its manufacture.

Much work was done with emulsions of petroleum fuel oil 24° Baumé, distillate or gas oil 28° Baumé, and two paraffine oils of 24° and 28° Baumé, respectively. The extensive use of these oils at proper strengths did no immediate damage to the foliage or fruit.

While it is a fact that oil sprays made without injurious chemicals and used properly cause no immediate damage and never any serious injury, they apparently interfere to a limited extent with the physiological processes of the tree. On March 30 and 31, 1911, a row of about 20 trees each was sprayed with petroleum fuel oil 1 per cent, distillate oil $1\frac{1}{2}$ per cent, paraffine oil 28° Baumé 1 per cent, and paraffine oil 24° Baumé 1 per cent. At the time of the application the leaves were the new ones of the first spring growth and had not become very green but were of a light yellowish green color.

After about two weeks it was noticed that the leaves of those trees that had been sprayed were still of a slight yellowish green and those left unsprayed had changed into a dark green. At the end of a month this difference had entirely disappeared, and so far as could be ascertained no permanent injury had been done. Although some difference may have existed according to our observations, none could be detected between those leaves sprayed with the distillate which was somewhat volatile and the heavy paraffine oil of 24° Baumé, which was very stable. This observation would indicate that the coating of the new leaves with oil spray interfered to a limited extent with the formation of chlorophyll.

The excessive use of sprays may be injurious and some tests were made to determine the accumulated effect of one of the above oils. The same trees were sprayed with the paraffine oil 24° Baumé using 1½ per cent of oil in the spray three times at intervals of six weeks during the summer, the first application being made May 13, 1911. The effect of these repeated applications was very marked. The leaves were small as compared with those from other trees. There were considerable dead twigs in the trees and the fruit was very small and very late and sour compared with the fruit from adjoining trees. There was no yellowing of the leaves, nor burning of the leaves nor fruit by these applications. The trees sprayed only once on May 13 and a check on the above were much improved by the application. It should be stated that a single application of a spray containing 1 per cent of the above oil instead of 1½ per cent as was used would have been sufficient to eliminate the damage caused by insects. No experiments were conducted to determine the accumulated effect of as weak a dilution as ½ of 1 per cent of oil but it is the opinion of the writer that such a dilution would not be injurious even though used very frequently.

The weather conditions which may exist at the time of the application may be of much importance. It has been known since Hubbard made his investigations that low temperatures following the application of kerosene emulsion would result in injury. This is due to the low temperatures preventing the evaporation of the kerosene, thus permitting it to remain for too long a time in contact with the leaves and interfere with their function. Those oils used in the manufacture of miscible oils as well as the petroleum fuel oil, distillate oil, and the paraffine oils are much less volatile than kerosene and consequently just as liable to cause injury when the application is followed by low temperatures. The author has sprayed thousands of trees and known of other thousands sprayed by other people and only one or two instances are known to him that disastrous results

followed. It is well, however, to cease spraying just before a freeze is predicted. It is well known that neither hot sun, nor shade, neither rain nor dry weather existing either during or following the application is influential in causing damage.

As yet no experiments have been conducted to determine the effect of these sprays on the bloom and it is inadvisable to use them during the blooming period.

It has been observed that the use of these oils, including kerosene emulsion, causes dim shadows or faint green blotches to appear on the fruit if sprayed early in the season. These disappear when the fruit colors up in the fall and this has never been considered a serious matter by the author.

Mr. H. J. Quayle: I agree with Mr. Yothers that the injury may be due to something other than the oil itself. We depend largely on distillate oils in California and they are used at a strength from 6 to 8 per cent on dormant trees. The latest use of oil there is the heavy crude petroleum, 16° to 18°, just as it comes from the wells and is used in the form of an emulsion with soap at a strength as high as 15 per cent. This seems to be the only thing that will control the Italian Pear Scale successfully. Thus far there appears to be no complaint of injury even with the heavy crude petroleum.

Mr. H. A. Gossard: A number of years ago I conducted some small experiments with oils, obtaining the same results as stated by Dr. Felt. Trees treated in the fall had some of the fruit buds killed, while no injury was done by spring applications. The manufacturers of the oil were quite perplexed and skeptical concerning my conclusions and went to considerable trouble to determine where the trouble lay. They took samples of the water used for diluting the oil and reported that they found considerable sulfur in it. They thought this was the explanation of the adverse result. Referring to spraying mixtures, I prefer to recommend the preparation that is nearest to "fool-proof" of any that I know. If I am writing to an experienced horticulturist, whom I know to be an intelligent sprayer, I use my best judgment in giving a prescription, but when making general recommendations for publication or when writing to strangers, I always want to name the nearest to a "fool-proof" remedy that I can. For this reason I prefer to recommend home-made lime-sulfur solution where practicable before the oils or the commercial mixtures.

Mr. T. B. Symons: In the case of peach lecanium the lime-sulfur will not phase it. We have to recommend the use of an oil mixture, but we state that the application should be made as late in the spring as possible.

President W. D. Hunter: The chairman suggests that it is getting rather late. Is there a motion for adjournment?

Adjournment.

Morning session, Friday, January 3d, 10 a. m.

President W. D. Hunter: The first paper is by Mr. W. B. Hungerford, on "The Success of a Two-Spray Calendar in a Kansas Orchard."

THE SUCCESS OF A TWO-SPRAY CALENDAR IN A KANSAS ORCHARD

By Herbert B. Hungerford, *Instructor in Entomology, University of Kansas*

This paper is given as a report of our spraying experiments in a Kansas orchard for the past season.

The purpose of these experiments was not to base the results on the fruit at picking time but to base them upon the entire history of all fruit set, from blossom time to maturity (and then to compare these results with those based upon counts made at picking time), in order to determine as accurately as possible the efficiency of our spraying methods.

The orchard problem in Kansas is not a simple one. Some sections of the state are infested with apple scab, others are free from that disease but are badly blotched. In some orchards curculio is doing serious injury to the fruit while others seem to be free from it.

We have been trying to get our apple growers to see that the only way in which they can expect to get the best results from spraying is for them to know what they are spraying for. In other words, that each man must diagnose the case of his orchard and then proceed to administer the dose. It is certain, however, that no one in Kansas will make a mistake in considering that his trees are suffering from a chronic case of codling moth and treating for that.

The managers of the larger orchards have found that it does pay to spray but many of the farmers having but small tracts of from five to ten acres have been skeptical.

It was to convince these skeptical ones, as well as to test out certain ideas of the department regarding spraying, that experimental orchard work was undertaken. An orchard of about ten acres, of from 15 to 18-year-old trees, located a couple of miles from the university was leased for a period of years. This orchard had been uncared for and had never produced a crop of marketable fruit. The department having had it under observation for some time, knew its ailments but obtained possession of it too late last year for the control of codling moth and curculio.

There were four things to be treated in this orchard: codling moth, curculio, blotch and bitter-rot.

When the petals were a little more than half fallen a spray was applied for codling moth. The earliest blooming varieties, Duchess of Oldenburg and Transparent were treated first and so on down the line. Each tree was sprayed at the right time, and sprayed as if it were not intended to be sprayed again. A little more than six gallons of spray were applied to each tree, leaving it dripping. The solution used was lime-sulphur and lead arsenate. It was applied with a drive spray nozzle with a pressure of from 180 to 280 pounds. The spray tank held 200 gallons and could be sprayed out in fifty minutes, but the difficulties of obtaining water made the job of spraying last a week.

About ten days later the trees were sprayed again, this time with a mist spray nozzle. The Missouri Pippins, Bens and Ganos were sprayed with Bordeaux and arsenate of lead, the other varieties with lime-sulphur and arsenate of lead.

The first of July the Pippins, Bens and Ganos were again sprayed with Bordeaux and arsenate of lead.

Within a radius of a half mile of the experimental orchard there were two or three unsprayed orchards and on the north end of the experimental orchard a block of trees was left unsprayed as check.

Certain average trees in the unsprayed orchards and in the experimental block were tagged while in bloom and counts made of all drops throughout the season, together with a tabulated report of the ailments of each drop. In all 81,457 apples were counted, tabulated and the results placed on a large chart. From this chart the tables herewith presented were made.

The Missouri Pippins, Bens and Ganos were given two sprayings with Bordeaux to control the blotch and bitter-rot of which there had been a heavy infestation in the past. As a result, there was no blotch whatever on the Ganos and Bens, and probably not over a score of apples affected with it on the twenty-eight Pippin trees,—a fact that it was difficult for us to believe. In a neighboring orchard, where a number of sprays had been but poorly applied, the blotch made unmarketable nearly every apple of the blotch susceptible varieties, namely, the Pippin, Winter Banana, Maidenblush, Lady-sweet, and several others.

The relation of the spraying to crop production is shown in chart number 1. Here there is recorded an historical summary of all fruit set. It may be noted that the drop in May was very large. This was what we have chosen to call the thinning drop. It was not possible to find any reason for most of these drops. In July there were many

SPRAY RELATION TO CROP PRODUCTION

CHART NO. 1: 81,457 APPLES COUNTED

	Variety	Total No. set	May drops	July drops	Aug. drops	Sept. drops	Total No. drops	Per cent dropped	No. picked	Per cent picked
Unsprayed	Gano	4,069	1,241	333	388	468	2,430	41.70	1,639	58.30
	Jonathan	4,966	417	547	564	1,612	3,140	60.35	1,826	39.65
	Winesap	6,401	630	249	487	1,285	2,651	35.45	3,850	64.55
	M. B. Twig	1,942	605	307	364	457	1,733	84.40	209	14.60
Sprayed Twice	Jonathan, 2 trees	4,436	697	32	226	1,108	2,063	36.50	2,363	63.50
	M. B. Twig, 1 tree	5,656	2,678	19	61	83	2,841	5.47	2,814	94.53
	Winesap, 2 trees	8,741	989	14	294	236	1,433	5.73	7,287	94.27
	Grimes G., 2 trees	15,681	4,856	63	420	541	5,880	9.47	9,791	90.53
Sprayed Three Times	Ben Davis, 2 trees	6,627	1,533	66	419	313	2,331	15.80	5,296	84.20
	Mo. Pippin, 2 trees	14,007	1,650	35	231	354	2,270	5.02	11,737	94.98
	Gano, 2 trees	8,931	1,889	97	400	404	3,690	25.28	6,366	74.72

more drops in the unsprayed block than in the sprayed. This was true throughout the remainder of the season, for it is to be noted that the numbers in the sprayed blocks represent the drops from two trees while in the unsprayed block the fall is from single trees. In the September drop the Jonathan of both sprayed and unsprayed ran high. This was attributed, the country over, to the weather conditions. In our country, however, the Jonathan seems to have the bad habit of letting fall its partly ripened fruit. Spraying tends to check this, for while the unsprayed tree dropped 1,612 apples, the sprayed only dropped 554. In the case of the Black Twig 84.4 per cent of the fruit that started out to grow fell by the way, while only 5.4 per cent of the sprayed fruit dropped

EFFICIENCY OF SPRAYING IN THE PRODUCTION OF SOUND FRUIT

CHART NO. 2: 81,457 APPLES COUNTED

	Total number of apples set	Thinning drop—May	Total number of unsound apples	Total number of sound apples	Per cent of sound apples
UNSPRAYED Orchard, 4 trees counted	17,378	2,893*	12,369	2,116	14.60
SPRAYED Orchard, 2 sprays, 7 trees counted	34,514	9,220*	1,592	23,702	93.81
SPRAYED Orchard, 3 sprays, 6 trees counted	29,565	4,847*	1,210	23,508	95.10

* Cause of drop undetermined and therefore not figured in the percentage of sound apples.

If we compare the efficiency of spraying in the production of sound fruit (chart number 2), we see that there was but 1.29 per cent difference between the twice sprayed and the thrice sprayed blocks. We must take into consideration, however, that the varieties differ and that the block sprayed three times contained blotch susceptible varieties, and the hardest apples to keep clean, grown in our state.

COMPARISON OF CODLING MOTH INFESTATION IN SPRAYED AND UNSPRAYED ORCHARDS

CHART NO. 3: 81,457 APPLES COUNTED

	Variety	Per cent Cod. Moth July drops	Per cent Cod. Moth August drops	Per cent Cod. Moth Sept. drops	Per cent Cod. Moth picked apples	Total per cent Cod. Moth of all apples set
	Gano	57.30	52.52	78.9	37.2	44.4
UNSPRAYED	Jonathan	92.15	74.35	74.6	49.5	56.3
	Winesap	92.00	52.30	76.3	19.2	32.8
	Black twig	82.20	89.50	95.4	66.6	58.2
SPRAYED TWICE	Jonathan, 2 trees	21.85	4.42	1.44	.88	2.02
1, as petals fell, with L. S. and Ars. L.	Black Twig, 1 tree	10.53	11.47	15.66	.74	.76
2, 10 days later, L. S. and Ars. L.	Winesap, 2 trees	50.00	11.62	11.42	1.20	2.98
	Grimes G., 2 trees	20.31	6.66	9.79	.64	1.47
SPRAYED THREE TIMES 1, as petals fell, with L. S. and Ars. L.	Ben Davis, 2 trees	7.58	2.62	6.07	2.53	2.33
2, 10 days later, Bd. and Ars. L.	Pippin, 2 trees	17.15	6.46	7.34	.80	1.03
3, July 1, Bd. and Ars. L.	Gano, 2 trees	11.33	3.00	5.45	2.20	2.04

In a comparison of codling moth infestation in sprayed and unsprayed orchards (chart number 3), we find that the per cent of codling moth infestation of dropped apples was much heavier in the unsprayed orchard than in the sprayed, and when we come to compare the percentage of infestation in picked apples, we discover that in the unsprayed blocks 19.2 to 49.5 of the fruit was wormy, while in the twice sprayed block three out of the four varieties produced less than one per cent of wormy fruit. In the block sprayed three times the infestation ran just a little higher.

If there were time it would be interesting to make a comparison of the varieties of apple in regard to their ability to withstand the infestation and still remain on the trees; for a comparison of the percentages of the infestation of picked apples and the percentages of

infestation based on all apples set would seem to indicate that some varieties do have a greater tendency to drop as a result of codling injury than others. This may be used to determine the relation of other insects to crop production, for while the per cent of codling moth infestation of all apples set runs higher than the one based on the apples picked, the reverse is true of curculio.

In the April JOURNAL Doctor Ball states "that records founded upon picked fruit only are untrustworthy and practically valueless for scientific purposes" and "that in all tests of efficiency absolutely accurate accounts should be kept of every fruit that sets[1] on the tree."

By placing the two percentage columns together as they are in chart 3 we see that there is considerable difference in the individual percentages and it is obvious that the one on the right more nearly presents the efficiency of our spraying operations.

COMPARISON OF CURCULIO INFESTATION OF SPRAYED AND UNSPRAYED ORCHARDS

CHART NO. 4: 81,457 APPLES COUNTED

	Variety	Per cent curculio August drops	Per cent curculio Sept. drops	Per cent curculio picked apples	Total per cent curculio apples set
UNSPRAYED	Gano, 1 tree	19.60	18.45	29.22	13.70
	Jonathan, 1 tree	15.13	21.85	40.52	22.23
	Winesap, 1 tree	23.66	22.66	48.54	33.92
	Black Twig, 1 tree	2.47	10.50	17.19	4.28
SPRAYED TWICE	Jonathan, 2 trees	10.60	.36	6.06	3.50
1, as petals fell, L.S., Ar. L.	Black Twig, 1 tree	4.92	12.04	2.83	1.64
2, 10 days later, L. S. and	Winesap, 2 trees	6.52	2.52	3.81	3.40
Ars. L.	Grimes G., 2 trees	10.48	8.50	1.78	1.69
SPRAYED THREE TIMES					
1, as petals fell, L.S., Ar. L.	Ben Davis, 2 trees	5.00	7.67	2.36	2.53
2, 10 days later, Bd. M. and	Pippin, 2 trees	5.18	6.22	1.87	1.84
Ars. L.	Gano, 2 trees	8.00	4.21	3.57	2.52
3, July 1, Bd. M. and Ar. L.					

Comparing the sprayed and unsprayed trees with reference to curculio infestation (Chart No. 4) we see that in the unsprayed orchard the infestation of the picked apples ranged from 17 per cent in the case of the Black Twig to 48.5 per cent in the Winesaps, while in the block sprayed twice the Black Twig showed an infestation of but 2.83 per

[1] In connection with the determination of efficiency in spraying operations it might be of interest to note that Dr. S. A. Forbes as early as 1885 based the results of his spraying experiments upon a history of all the fruit set. Dr. Forbes is, the writer believes, the first to apply this method to insecticide work.

cent and the Winesap, but 3.81 per cent. The Jonathan tree in the unsprayed block had more than 40 per cent of its fruit damaged while the one sprayed twice was injured to the extent of only 6 per cent. The unsprayed Gano showed an infestation of nearly 30 per cent, the one sprayed three times, less than 4 per cent.

This again shows the inaccuracies that might result from basing spraying results upon the fruit at picking time, for the actual control was not as the above statement would indicate. For instance, the Black Twig in the unsprayed block had less than 4 times the infestation of the sprayed block, while the former figure gave an apparent control of 1 to 6. The Winesap results varied from an apparent ratio of 1 to 13 to an actual of 1 to 10.

An examination of Chart No. 4 fails to show any reason for the third spray for curculio. It is worthy of note in this connection, that no early sprayings were made for this in these experimental blocks, the control being due to those applied for the Codling Moth.

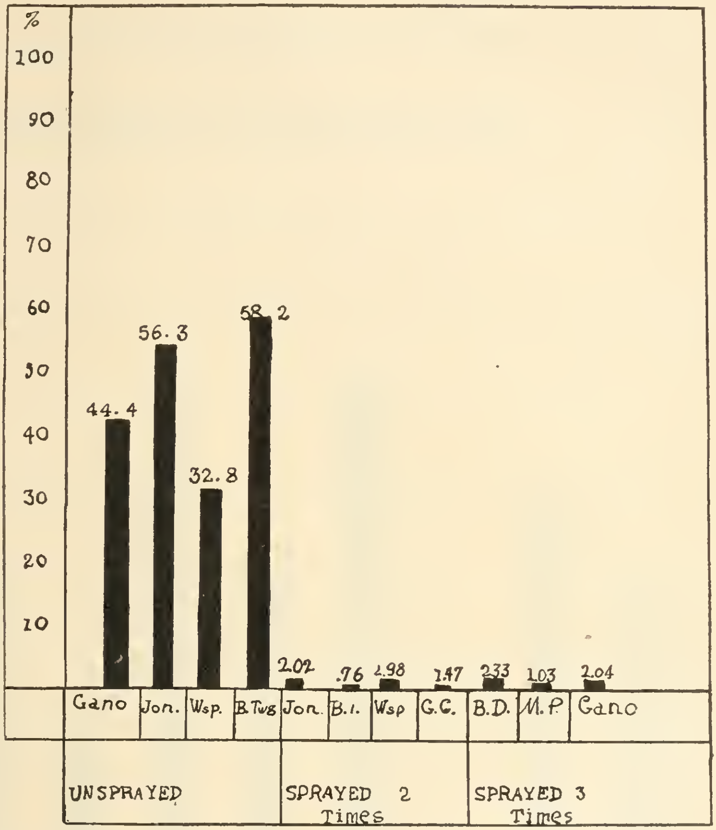
COMPARISON OF BITTER ROT INFESTATION IN SPRAYED AND UNSPRAYED ORCHARDS

Chart No. 5: 81,457 Apples Counted

	Variety	Per cent B. R. July drops	Per cent B. R. August drops	Per cent B. R. September drops	Per cent B. R. picked apples	Total per cent B. R. apples set
Unsprayed	Gano	4.77	4.64	22.66	9.70	7.40
	Jonathan	.91	2.13	13.53	6.96	8.14
	Winesap	.00	6.57	27.07	11.16	11.10
	Black Twig	.30	3.85	15.56	3.35	4.78
Sprayed Twice						
1, L. S. and Ar. L., as petals fell	Jonathan, 2 trees	.00	3.61	.18	.29	.67
2, L. S. and Ars. L., 10 days later	Black Twig, 1 tree	.00	4.92	6.02	.00	.14
	Winesap, 2 trees	.00	6.05	.00	.41	.77
	Gr. Golden, 2 trees	1.58	3.09	4.25	.06	.40
Sprayed Three Times						
1, L. S. and Ars. L. as petals fell.	Ben Davis, 2 trees	.00	3.12	12.02	1.32	1.82
2, Bd. and Ars., 10 days later.	Pippin, 2 trees	.00	3.54	.28	.29	.32
3, Bd. and Ars. L., July 1	Gano, 2 trees	.00	9.00	4.95	.83	1.20

The experimental orchard had been badly infected with bitter rot and though the present season was considered a good bitter rot season, it is interesting to note that it was a negligible quantity in the twice sprayed orchards though running from 4.7 per cent to 11 per cent in unsprayed blocks.

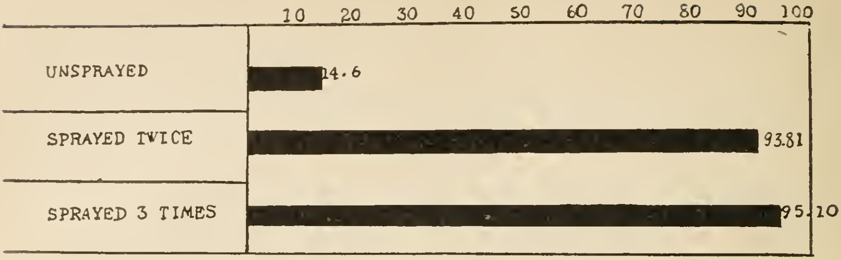
The following charts show graphically what has been above presented.



SHOWING CODLING MOTH INFESTATION OF SPRAYED AND UNSPRAYED TREES

Chart No. 6

In Chart No. 6 the columns represent the codling moth infection. The high ones on the left show the infection in the unsprayed orchard, the ones on the right, in the sprayed blocks. As might be expected there is no marked difference between the two and three spray blocks.

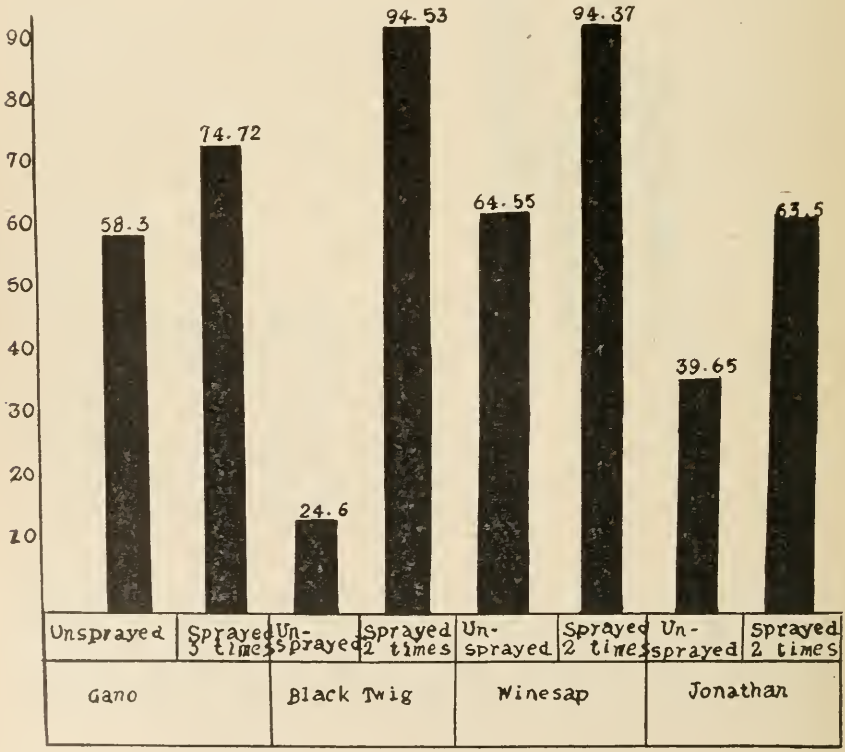


EFFICIENCY OF SPRAYING IN THE PRODUCTION OF SOUND FRUIT

Chart No. 7: Showing graphically per cent of sound fruit on sprayed and unsprayed blocks

(Columns represent sound fruit)

The columns in Chart No. 7 represent the per cent of sound fruit produced.



SPRAY RELATION TO CROP PRODUCTION

Chart No. 8: Showing graphically the per cent of all apples set, which were on the trees at picking time, regardless of injury on sprayed and unsprayed trees of the same variety

From Chart No. 8 we see that the sprayed orchard produced from one-third more to seven times as much fruit as the unsprayed.

Inasmuch as spraying results have generally been based upon one or the other of the ratios given we thought that it might be of interest in recording our results to present both percentages. We have found that the results would be quite different in some cases. Both figures, however, show that the insect pests of this orchard were controlled by two sprays, and though no conclusions could be drawn from one orchard or from one season's work, studies made in many orchards scattered over the southern portion of the state lead us to believe that in the majority of cases two sprays are sufficient for the control of such insect pests as we have in Kansas.

As one who has looked at the problem from the commercial side we would say that the entomologist should recommend as few sprays as possible for the best returns, for the long spray calendar usually recommended has a tendency to discourage many of our small orchard holders from attempting to spray at all. But in the last analysis the recommendations should be specific rather than general.

President W. D. Hunter: This paper is before you for discussion.

A Member: What time during the year did you spray for "bitter rot"?

Mr. W. B. Hungerford: We only made one spray solely for "blotch" and none for "bitter rot alone."

Mr. T. B. Symons: Is Bordeaux better than lime-sulfur?

Mr. W. B. Hungerford: Yes, but there is a difference in seasons. Last season we had some injury from lime-sulfur.

President W. D. Hunter: We will proceed with the next paper by Dr. Felt, on "The Codling Moth and One Spraying in the Hudson Valley."

THE CODLING MOTH AND ONE SPRAYING IN THE HUDSON VALLEY

(Abstract)

By E. P. Felt, *Albany, N. Y.*

Spraying experiments for the codling moth have been conducted during the past four seasons in Hudson valley orchards. In each instance the work was planned along practical lines so far as possible and special pains taken to secure only fairly representative trees in orchards kept in a good horticultural condition. Invariably the spraying outfit and the men on the place were employed, the entomologist contenting himself simply with explaining his methods and insisting upon reasonable thoroughness in treatment. The experiments were conducted in four well separated localities, while the

trees selected were of the standard varieties, being Baldwins, Greenings, Northern Spy and Ben Davis. The diversity of season, location, equipment and men, and the different varieties used for the tests prevent these experiments being classed as local or exceptional. The spraying was invariably given as soon as possible after the dropping of the petals, special pains being taken to throw the poison down upon the upturned ends of the young apples, though during the last three years it was not deemed advisable to attempt to force the spray into the lower calyx cavity.

The results obtained during this period are shown in the following tabulation.

SUMMARY OF RETURNS FROM CHECK OR UNSPRAYED TREES

Plot	Series	Year	Total fruit	Clean Fruit		Wormy Fruit					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
Check ..	1	1909	3,251	2,366	72 73	885	27.27	312	302	271	
Check ..	2	1909	7,015	5,127	73.08	1,888	26 92	674	630	584	
Check ..	1	1910	711	202	28 41	509	71.59	186	240	82	
Check ..	2	1910	2,000	593	29.65	1,407	70.35	700	324	383	
Check ..	1	1911	5,337	4,540	85.06	797	14.94	379	166	252	
Check ..	2	1911	14,670	9,860	67.21	4,810	32.79	2,048	949	1,813	
Check ..	2	1912	878	342	39.95	536	61.05	212	238	86	
Grand total			33,868	23,030	67.99	10,832	32.01	4,511	2,849	3,471	21.73

SUMMARY OF FOUR YEARS WORK WITH ONE SPRAY FOR THE CODLING MOTH

Plot	Series	Year	Total Fruit	Clean Fruit		Wormy Fruit					
				Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy	Per cent end wormy
1	1	1909	30,177	29,818	98.81	359	1.19	33	18	308	
4	1	1909	20,313	20,017	98.55	296	1.45	31	6	259	
1	2	1909	21,264	21,042	98.96	222	1.04	23	18	181	
4	2	1909	9,852	9,683	98.27	169	1.73	19	13	137	
7	2	1909	19,091	18,617	97.52	474	2.48	51	32	391	
1	1	1910	1,839	1,664	90.48	175	9.52	16	21	138	
1	2	1910	8,135	6,677	82.08	1,458	17.92	160	27	1,271	
1	1	1911	16,638	16,515	99.26	123	.74	19	12	92	
1	2	1911	20,802	20,401	98.07	401	1.93	28	14	359	
1	1	1912	11,138	10,833	97.26	305	2.74	14	16	275	
2	2	1912	10,029	9,898	98.69	131	1.31	13	13	105	
Grand total			169,278	165,165	97.56	4,113	2.44	407	190	3,516	.353

It will be seen that the check plots during this four-year period gave an average percentage of sound fruit amounting to 67.99, the yield in individual plots varying from 28.41 to 85.06 per cent. The average percentage of end wormy fruit for these plots is 21.73, a marked contrast to what was obtained from the sprayed trees. The returns from these check trees may be briefly summarized as follows: Approximately one third of the fruit was wormy and nearly two thirds of the wormy apples were entered at the end or end wormy.

The above data show that one spraying during this period produced from 82.08 to 99.26 per cent of sound fruit or an average of 97.56 per cent for the four years when comparisons are made between an equal number of plots in each year. In explanation it should be stated that the figures for several plots in 1909 were omitted in calculating the averages simply to give more nearly equivalent values to the returns obtained for the four year period. Attention should be called to the relatively low percentages of 1910, a season remarkable for the unusual destructiveness of the second brood and one presenting infrequent conditions which were further accentuated by the small yield of that year. Excluding the data for that season, the lowest percentage of sound fruit obtained from one spraying was 97.52. It is worthy of note that only a little over one third of 1 per cent (.353 per cent) of the wormy apples were end wormy, a striking contrast to the 21.73 per cent end wormy on the check or unsprayed trees.

A study of the above data justifies the conclusion for the Hudson valley at least, that in normal seasons when the crop is abundant or fairly so, one thorough early spraying within a week or ten days after the blossoms fall and preferably early during that period, should result in securing from 95 to 98 per cent of sound fruit. Our data show that the benefit resulting from two later sprayings is comparatively small so far as controlling the codling moth is concerned though ample to meet the cost of the posion and, in many instances, probably the expense of treatment.

President W. D. Hunter: This paper, which has well summarized an important line of work, is now before you for discussion.

Mr. W. E. Britton: Whether we use one or more sprayings against the codling moth will depend upon local conditions. In Connecticut there are several neglected orchards where 80 per cent of the unsprayed fruit shows codling moth injury. In other orchards which have been sprayed for several years there may be not more than 10 per cent of wormy unsprayed fruit. Last fall I saw a tract of land in Connecticut, purchased twenty years ago as an abandoned farm. It was rough and grown up to bushes. Fifteen years ago some of the land was

plowed and planted to apple trees, chiefly Baldwins and Greenings. The past year these trees were given one spraying with lead arsenate (no fungicide) and I never saw a finer lot of fruit.

Mr. T. B. Symons: I would like to ask Dr. Felt if he used any fungicides.

Mr. E. P. Felt: Yes, but we did not pay any attention to it. I should not be understood that one spray is always sufficient. I believe that if we are working to get results with one spray it is necessary to keep the orchard in a good condition from a horticultural standpoint. After one or two years, and if there were no local disturbing factors I should expect to get 95 per cent worm free fruit.

Mr. H. A. Gossard: We have tested the one spray method a few times in Ohio. One of our orchardists tried it and he reported that his results were entirely satisfactory. Another man equally thorough in his work has tried the same thing two or three times and has failed, so there must be some local disturbing conditions. We have several orchards which have been sprayed under the supervision of the Station for seven or eight successive seasons. One man sprays twice; once immediately after bloom and again about a week or ten days later and usually has from 98 per cent to 99 per cent of sound fruit. Another orchardist with whom we coöperate, whose trees are more open and who does not use quite so much liquid as the former, finds it almost necessary to give two sprays, one after the bloom and one about the last of July. Some have both the lesser apple worm and the codling moth to fight. It seems to be a matter of judgment depending on local conditions as to whether or not a second application can be safely omitted.

Mr. S. J. Hunter: We applied one spray last year when the blossoms were about one-half fallen and a second after the calyx cup closed on our wine saps and at picking time 98 per cent were sound.

Mr. T. J. Headlee: I may be repeating what someone else has said; but if that be so it will only serve to emphasize what our experience has indicated as a very important point. The orchardist is all too ready to grasp at any suggestion emanating from reliable sources which promises to reduce the amount of work necessary to produce a crop. In our work in Kansas orchards we have invariably found both codling moth and curculio, and in no case in the course of two years extensive tests have we found the one spraying sufficient and satisfactory. In view of these facts we believe that the advocacy of a single spraying for the control of insect and fungous enemies, in Kansas orchards at least, to be inimical to the best interest of the fruit grower.

Mr. E. P. Felt: I sympathize with the speaker, and yet I find myself confronted by facts. I find myself talking to men who have made one spray for the codling moth and got the results. I believe that we,

as scientific men, must recognize the possibility of the one spray and I do not see the slightest danger in calling attention to it. Professor Quaintance reports in spraying against codling moth and curculio, that there was not much difference between trees that received one application and those which received three, and sometimes five applications. In the Hudson Valley we can do more to emphasize the importance of one spray, with a warning that at times it may not be sufficient, rather than to urge several treatments. I may say further that I have yet to find very serious insect injury from various leaf feeders in orchards that have systematically received one spray annually.

Mr. P. J. Parrott: Is it not a fact that apple scab is not as injurious along the high lands of the Hudson River as in some portions of western New York?

Mr. E. P. Felt: These results do not necessarily apply to the western part of the State.

President W. D. Hunter: The next paper is by Mr. P. J. Parrott entitled, "Notes on Three Tree Crickets."

NOTES ON TREE CRICKETS

P. J. Parrott and B. B. Fulton

Recent years have been very prolific in comprehensive economic entomological treatises of a general nature. As these have come into our possession we were invariably prompted by reason of our interest in tree crickets to turn early to the pages dealing with them. A perusal of the subject-matter has impressed us either with the prevailing misconceptions regarding their habits or with an apparent lack of certainty which has led to indefiniteness of statement. The accompanying brief notes are here given to call attention in a way that we have not been able to do heretofore to certain habits of *Oecanthus niveus* De Geer, *O. nigricornis* Walk, and *O. quadripunctatus* Beut., which are the most common species in plantings of small and tree fruits in New York.

The species *niveus*, popularly known as the snowy tree-cricket, deposits its eggs singly, which habit distinguishes it from the foregoing associated forms. In the region about Geneva oviposition is most abundant in apple, plum, cherry and elm, and to a much less extent in peach, walnut, wild crab, hawthorn, witch hazel, chestnut, red oak, maple, butternut, lilac and raspberry. With old trees the eggs may be found principally in the thickened bark about the bases of fruit spurs or branches or in the bark of the larger branches, while with small trees they also occur in the bark of the trunks. In spite of the large numbers of the adults which may be observed in raspberry plantations, other

plants, as enumerated above, seem to be much more preferred for purposes of oviposition. With this fruit the eggs are inserted singly at the sides of the dormant buds in the fleshy region at the axils of the leaves.

This species derives its economic importance largely from its injurious work on apple trees, especially in neglected plantings, which sometimes are quite badly scarred as a result of the wounds caused by the oviposition punctures. The penetration of the tissues by the ovipositor may apparently be also attended by infection with some unknown fungus or bacterial organism, which not infrequently forms a canker, indistinguishable in its external appearance and effects from the New York apple-tree canker (*Sphaeropsis malorum* Pk.) or the blight canker of apple trees (*Bacillus amylovorus* [Burr] de Toni). The woolly aphis may also establish itself in wounds made by this cricket and thus aggravate the primary injuries.

The species *nigricornis* differs in its oviposition habits from *niveus* by depositing its eggs in long rows. It prefers for the reception of its eggs raspberry, blackberry, horseweed (*Erigeron canadensis* L.) and goldenrod, *Solidago* spp. Oviposition occurs to a less extent in twigs of willow, elder, maple, elm, sumac, grape and peach. This species has been discussed by many writers under the name of *niveus*, and judging from the accompanying illustration in their accounts it would appear that *nigricornis* deposits its eggs in a great many plants in addition to the foregoing, as currant, artichoke (*Helianthus* spp.); *Ambrosia* spp., cottonwood, box elder, cherry, dogwood, black locust, sycamore, ash, honey locust, and catalpa. This cricket is sometimes quite destructive in raspberry plantings as the wound made by the deposition of so many eggs may cause the death of the terminal growth of the shoot or loss of fruit from the breaking off of the cane at the point of injury.

The species *quadripunctatus* may be observed occasionally in raspberry plantings in company with *niveus* and *nigricornis*. It is, however, of no economic importance. It oviposits in weeds, principally

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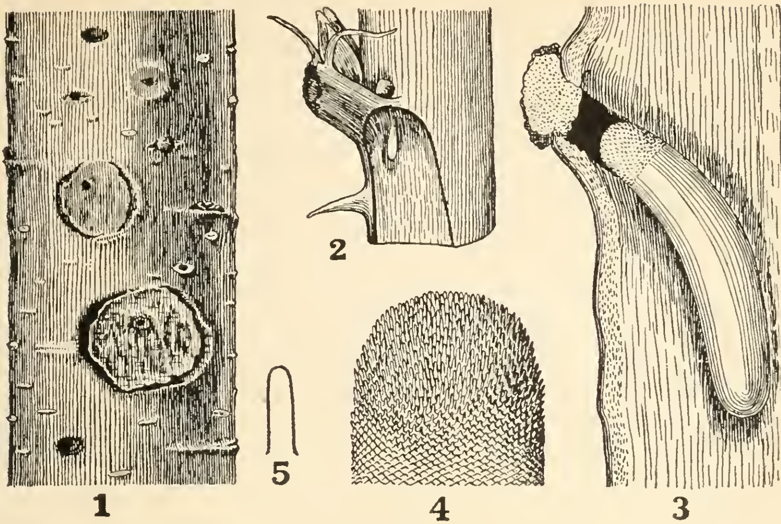
Oecanthus niveus, A.—1, Apple wood showing egg punctures and diseased areas, x1½; 2, Egg at base of petiole in raspberry, showing normal oviposition in this plant, x2½; 3, Egg, showing its position in apple bark, x15; 4, Egg cap showing spicules, x50; 5, Spicule showing characteristic outline, x500.

Oecanthus nigricornis, B.—1, Row of egg punctures in raspberry, x1½; 2, Longitudinal section of the same, x3; 3, Egg, x15; 4, The egg cap, x50; 5, A single spicule of the cap, showing characteristic outline, x500.

Oecanthus quadripunctatus, C.—1, Egg punctures in wild carrot (*Daucus carota*), x1½; 2, Longitudinal section of the same, x3; 3, Egg, x15; 4, Cap of egg, x50; 5, A spicule of egg cap, showing characteristic outline, x500.



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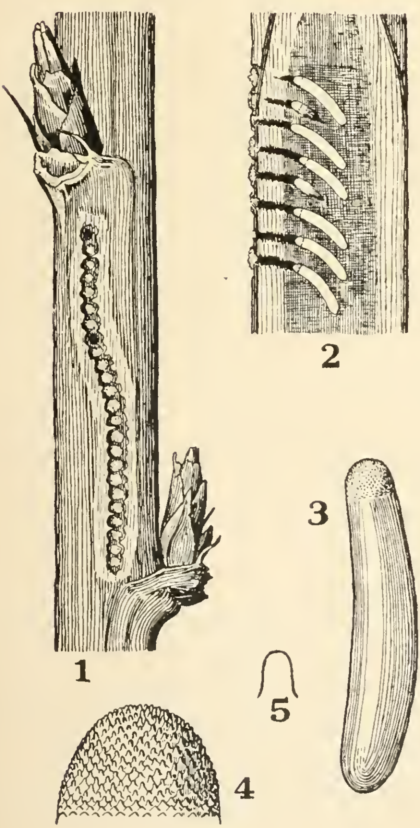

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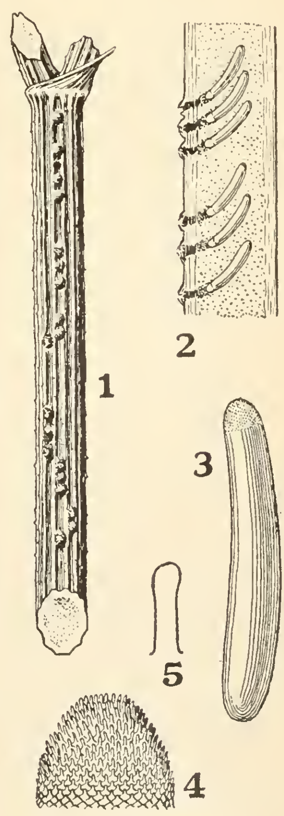

C

the wild carrot (*Daucus carota* L.), goldenrod and aster. Like *nigricornis* the eggs are deposited in rows, but the insect seems to prefer stems and stalks of five millimeters or less in which to place them.

President W. D. Hunter: Any discussion on this paper?

Mr. W. E. Britton: Which species lays eggs in rows on the peach trees?

Mr. P. J. Parrott: That is *Oecanthus nigricornis*.

A Member: Do you know of a species which lays three or four eggs deposited on either side of a wound?

Mr. P. J. Parrott: This is the work of another species which we hope to study. It is apparently a southern species.

President W. D. Hunter: The next paper is by Mr. R. L. Webster on, "The Arrangement of the Material for an Entomological Bulletin."

THE ARRANGEMENT OF MATERIAL IN AN ENTOMOLOGICAL BULLETIN

By R. L. Webster

Several years ago, when preparing an outline for a bulletin, it struck me that the usual order of arrangement of matter in entomological bulletins in general was not that demanded by an economic treatment. It seemed to me that it was quite unnecessary to thrust on the farmer and fruit-grower a detailed account of the past history, the synonymy, the stages and the habits of an insect, before giving him a word concerning the control measures; the thing in which, presumably, he is most vitally interested. And I had heard the complaint that "we can't find things in the bulletins," for which there must have been a reason.

With this idea in mind I attempted to work out an arrangement by which an insect could be treated of in a more logical manner, from an economic standpoint; an order that would throw the popular treatment and the control measures in the fore part of the bulletin, where they may be seen easily, and place all the more technical matter in the latter part.

Most of the entomological bulletins published in this country have been concerned with individual species of insects although bulletins which consider insects in economic or systematic groups have not been uncommon. Of these last I am not so directly concerned in this paper, which will refer, for the most part, to a bulletin considering a single insect; in other words, to a monographic bulletin.

The usual order in a bulletin of this kind is an historical one, which first treats of the insect's past history, its destructiveness, and the

synonymy, which is followed by an account of the generations and the stages, and which concludes with a discussion of the natural enemies and the control measures. In using such an arrangement the entomologists in this country seem to have followed the custom of Fitch, Riley and Lintner. Both Riley and Fitch used this general arrangement to a considerable extent but it was most used by Lintner, whose entomological articles were almost entirely written up in this historical order.

Now this is a logical order from the standpoint of pure science. It is perfectly intelligible to the entomologist and in consequence it seems proper to use. It is quite natural to lead up to the control measures for an insect after a full discussion of its habits and life history, upon which the control measures depend.

But an entomologist should write not only for his fellow-entomologists, but for all his readers, and especially for the man to whom his writings ought to be of most use, the man whose crops are damaged by insect pests. Our bulletins are sent to a very large number of people, of whom only a very few know much about insects. The whole mailing list at the Iowa Experiment Station amounts to something like 20,000, of which not more than 400 at the most are entomologists. So it seems to me that it is my business to write my bulletins, if I am able to do it, for the whole 20,000, rather than only for the 400.

You cannot expect the average farmer to become an entomologist; the best educated farmer will have difficulty in wading through an entomological bulletin containing any great amount of technical matter. It appears to me that it is the place of an entomologist to become a farmer, so far as he is able, when he attempts to write an article which he expects the farmer to understand. It certainly is not beneath his dignity to attempt such a thing, in fact it is quite possible that he might become a better entomologist and be more appreciated by those who read his bulletins if he should do something of this kind.

In this connection I may well refer to a portion of the presidential address given before this association in 1893, by Dr. S. A. Forbes. Dr. Forbes said " . . . I am inclined to think that we are very likely to forget, when we prepare our reports, that we are writing largely for men to whom entomology is a perplexing, obscure and displeasing subject, of which they know little or nothing, and especially nothing good; but on the other hand, they are frequently experts in crop inspection, far quicker, as a rule, to observe injuries to their crops than we are, and more likely to discriminate them nicely. If we had always borne this fact in mind, I think that our economic articles would usually have taken quite a different form. The crop injury, and

its characteristic appearances would have led in our discussions, and remedial and preventive measures would have followed thereupon as immediately as practicable, the insect itself being brought in, if at all, in a strictly subordinate way, as an aid to the recognition and classification of the injury, and as a guide to the selection of an economic method."

In the discussion of teaching methods of entomology, at the Minneapolis meeting of this association, this same point was brought out. That teaching which reasoned from the injury to the insect was more effective than with that method reversed, was the meat of the discussion. In other words the matter was better considered from effect to cause, rather than from cause to effect, as Prof. J. G. Sanders then put it.

Where an economic group of insects has been concerned, the consideration of the whole subject according to the injury to the plant often has been used. Saunder's "Insects Injurious to Fruits" and Forbes monograph of corn insects (18th and 23d reports) will remain classic examples of this kind. Insects are there considered as attacking leaves, or branches, or roots, etc., as the case may be, the order of their consideration depending on an economic, rather than on a systematic relationship.

Certainly it is the injury to a crop that the farmer notices before anything else. Many a time he does not see the insect which has caused an injury, sometimes he sees the wrong insect, but he does see the damage. Then it is the damage of an insect to a plant that is the logical thing with which to start an entomological article of economic importance. Now it seems to me that, having attracted the reader by a description of the injury, something with which he may be more or less acquainted, his attention may be held for a few succeeding paragraphs, in which the insect may be very briefly described, and the life history in its essential details given. At this point only the bare essentials need be given, just enough to give a clear idea, nothing more. The weak points in the life history, where the insect may be reached by control measures, should be brought out quite distinctly at this point. This part of the text, also, is the place for illustrations of injury, and the insect as well, which tell more than pages of text.

Now the control measures may be discussed, for that is the point we have been trying to reach all the while. This is likely to be more in detail, if much experimental work has been done, but there is no reason why it cannot be put in popular language. In concluding the discussion of the control measures definite steps may be advised for the insect. This completes the popular portion of the bulletin, and so far the reader may go without encountering a single technical word,

unless it be the words larva, pupa or adult, and the meaning of these the average reader ought to know. I think it is best to explain these common terms the first time they are used in the text, afterward using them without further explanation. If a popular edition of the bulletin is to be issued, the first part of the regular edition, including the discussion of the control measures, may be printed as a separate bulletin.

Having concluded that part relating to the measures for control, we are now ready for the more technical treatment, such as the past history, the synonymy, the stages in detail and the natural enemies of the insect. In this part of the bulletin we are writing more for entomologists; few others will pay very much attention to the technical portion. Order is less important here, since the entomologist will look for those things in which he is interested, and on account of his training he is able to pick out more easily the essential points. But we must have some order, and the chronological order such as indicated appears to serve as well as any other. The position for the bibliography is, of course, at the end.

Summaries are frequently placed at the end of a bulletin; a rather natural position. Personally, however, I like to see them at the front, where they may be encountered as soon as a bulletin is opened, and boiled down to a single page, giving the real essentials of the bulletin.

Such an arrangement of material as has been here indicated the writer has been using in entomological bulletins of the Iowa Experiment Station during the past four years and it has proved to be very satisfactory.

In order to bring out the arrangement here considered a little more clearly, there is given below an outline on which a bulletin of this kind may be built up. This refers to a monographic bulletin, concerning one insect.

1. Summary.
2. Recent injury.
3. Appearance of the injury.
4. The insect's appearance (brief descriptions)
5. Time of appearance of the generations (briefly).
6. Control measures.
7. Steps advised.
8. Past history.
9. Destructiveness.
10. Distribution.
11. Food plants.
12. Classification.
13. Life history.
    a. Generations (in detail).
    b. Stages (detailed descriptions).
14. Natural enemies.
15. Bibliography.

It may be seen that the matter is easily divided between the numbers 7 and 8. Before this division is considered only the broader aspects of the problem, after it comes the detailed account.

This arrangement of a bulletin, which I have taken up at some length, is not a change of the matter treated, but only a change in the order. It is an arrangement which may not fit any and every bulletin, but it may be adapted to a great number of them, and especially to those concerning a single insect. This order in a bulletin, based as it is on the economic treatment of an insect, is, it seems to me, an order that is more readable, more interesting and more intelligible to the average farmer or fruit-grower than the order generally followed.

President W. D. Hunter: This interesting paper is now open for discussion.

Mr. F. L. Washburn: I think the summary should be at the beginning of the paper so that the farmer on opening the publication can see in a brief way what results have been secured. The summary should be in the beginning or at the end in bold type. We have to consider not only the farmer but also other entomologists who may criticize if we omit the technical part. The latter can be published separate from the economic part.

Mr. W. E. Britton: I agree with Mr. Webster, and yet there are some of us who are not able to publish as we should like to on account of certain methods having been adopted by the directors of the stations. I think that perhaps the best place for the summary is in the beginning. The back page on the outside is also a good place, where it may be seen without opening the bulletin. Many times the subject matter must determine the form in which it is written. It is perhaps better to put in one place all the most important facts, provided this part is separated so that the farmer can readily see it.

Mr. E. P. Felt: I think this subject is one of importance. It is a study in the psychology of presentation. I have been wondering how many men know the actual efficiency of the bulletins sent out from their offices. Sometimes it is just as well to write one paragraph and have it read by 10,000 as to write 10,000 paragraphs and have them read by one. We should use the local press at the time insects are causing damage. I go into many homes and it is only once in a while that I find a man who keeps entomological publications. There are only a few who keep them and I do not know of one man who could place his hands on the desired book. I have been wondering if a group of interested men could make some studies of this and report to us.

President W. D. Hunter: Dr. Felt has made a suggestion that is

worth our consideration. I would like to ask if he wishes to place it in the form of a motion.

MR. E. P. FELT: I think the information might be useful to some of our men and I move that the chairman appoint a committee of three to investigate the use to which our publications are put and report at the next meeting.

MR. T. B. SYMONS: I believe the press bulletin and such forms of matter that are gotten out from week to week are very useful supplements to the general station bulletins. I second Mr. Felt's motion. I have been wondering if we should not have a press committee whose business it would be to see that our meetings are advertised in a general way throughout the country.

By vote of the Association the motion was carried.

PRESIDENT W. D. HUNTER: The next paper will be by Mr. A. W. Morrill on "Entomological Pioneering in Arizona."

ENTOMOLOGICAL PIONEERING IN ARIZONA

By A. W. MORRILL, *Phoenix, Ariz.*

In the selection of my title for this paper I do not wish to intimate that my field of action during the past three years has been one heretofore completely ignored by entomologists. It is a fact, nevertheless, that Arizona is entomologically in a pioneer stage of development. One by one the last few remaining states and territories have been yielding to the necessities for the organization and maintenance of an entomological service, and, not to be last, Arizona gave recognition to these necessities in 1909. Until that year Arizona was, in the words of Director R. H. Forbes of the State Experiment Station, "Entomologically lawless," and I may add entomologically needy of exploration and investigation. The state was, and is, a field for entomological work uniquely varied in itself, attractively different from other sections in its native insect fauna and above all affording excellent, if not unexcelled, opportunities for accomplishment in the exclusion of undesired pests as well as in insect investigations. Before dealing with the more recent entomological records and events, I will briefly review the "lawless" era prior to 1909 and as a further introduction I will outline our peculiar climatic and agricultural conditions upon which our entomological status, particularly from an economic standpoint, is dependent.

HISTORICAL. An examination of the indices of the Experiment Station Record, "Insect Life" and of other publications of the United States Department of Agriculture shows that in economic literature published prior to 1909, references to Arizona insects rarely occur. A

nearly complete history of economic entomology in Arizona up to the year mentioned is contained in the bulletins and reports of the State Agricultural Experiment Station. This Station was permanently organized in 1890 and two years later Prof. J. W. Toumey, now of the Yale Forestry School, was appointed botanist and entomologist in which capacity he served for about four years, when the title of entomologist was dropped. Professor Toumey's projects for investigation appear to have been confined to plant diseases. Two brief entomological bulletins were prepared by him, however, and published by the station.[1] Attention should be called here, in passing, to one of Professor Toumey's annual reports which will probably forever represent the irreducible minimum in departmental reports and serve as a standard which those of us subject to attacks of verbosity may well strive to emulate. Thirteen lines with a total of eighty-one words comprised the full text of this report.[2]

In October, 1899, Prof. T. D. A. Cockerell, at that time of the New Mexico Agricultural College, was engaged by the Arizona station to visit the Salt River Valley and to report upon the entomological conditions found there. As a result of this visit Bulletin 32 entitled "Some Insects of the Salt River Valley and Remedies for Them" was issued by the Experiment Station in December, 1899. This bulletin contains many interesting observations along economic lines and is one of our principal sources of information in regard to the status of insect pests in Arizona prior to 1909.

From 1900 to 1909 Professor Cockerell served as consulting Entomologist of the Arizona Station. During this time he contributed historic and descriptive matter and biological notes to Bulletin 56 dealing with the date palm scales (*Parlatoria blanchardi*) and (*Phoenicococcus marlatti*). During this period, also, various resident members of the Experiment Station staff,[3] included in their annual reports brief comments and notes on Arizona insects and entomological conditions. In regular bulletins, a chapter on "Extermination of Date Palm Scales" was contributed by Director R. H. Forbes to Bulletin 56, being based upon field work of which he assumed personal charge; and in Bulletin 58 Dr. J. E. Coit, then horticulturist on the Station Staff, devoted several pages to a discussion of citrus insects with original records of observations on the soft brown scale (*Lecanium hesperidum*), the citrus thrips (*Euthrips citri*) and the western leaf-footed plant bug (*Leptoglossus zonatus*).

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[1] Bul. 9, Insects and Insecticides, 10 pp. (1893), Bul. 14, Notes on Scale Insects in Arizona, 28 pp. (1895).

[2] Ninth Annual Report, Agr. Exp. Sta., p.——, (1897).

[3] Director R. H. Forbes, Prof. J. J. Thornber, Prof. A. M. McClatchie, Prof. V. A. Clark, and Dr. J. E. Coit.

It is a matter of record which required no little searching of the statutes of the Territory of Arizona to disclose, that two laws relating to insects were enacted before the Horticultural Inspection Law of 1909. In 1891 a law was enacted providing for County Boards of Horticultural Commissioners to be appointed upon the initiative of orchard owners after the plan and with the authority and duties prescribed by the similar law at that time in effect in California. As far as known no county ever availed itself of the opportunity for horticultural protection afforded by this law and its existence has been generally forgotten.

The discovery of foul brood in a few colonies of bees in the Salt River Valley led to the enactment of an excellent law in 1899 entitled "An act providing for the suppression of foul brood among bees." Prompt action was taken in the extermination of diseased colonies and foul brood has never been known to exist in the state since that time, although in the Salt River Valley alone there are today between fourteen and fifteen thousand colonies of bees. For some unexplained reason the Foul Brood Law was not included in the 1901 Revision of the Territorial Statutes and at present we are as a consequence without any provision for apiary inspection or legal authority to act in case of the discovery of bee diseases.

The only insect legislation other than the foregoing, up to the year 1909, was embodied as a single clause[1] in an appropriation bill passed by the territorial legislature in 1907 providing the State Experiment Station authority to inspect and treat date palms for insect pests.

The first permanent organization of an entomological department in Arizona was provided for in 1909 by the passage of the Horticultural Inspection Law. The writer was appointed Entomologist for the Arizona Horticultural Commission and at the same time Entomologist for the Arizona Agricultural Experiment Station in September of that year. The progress of entomological work in the state since that time has been recorded in the four annual reports of the Arizona Horticultural Commission and in the twenty-first and twenty-second annual reports of the Arizona Agricultural Experiment Station.

General Climatic and Agricultural Conditions. The climate of the state of Arizona is characterized by a low rainfall, low humidity and a high percentage of sunshine. From Yuma with an altitude of 141 feet, a mean annual rainfall of 3.13 inches, an average humidity of 46 per cent, an annual mean temperature of 72.1° F., and recorded extreme temperatures of 22° and 118° F., Arizona includes under cultivation all gradations up to Flagstaff at an elevation of 6,907 feet

[1] The text of this clause is included in the First Annual Report of the Arizona Horticultural Commission, p. 2.

with a mean annual precipitation of 23.87 inches, an average humidity of 62 per cent, an annual mean temperature of 44.7° F., and recorded extremes of −21° and 93° F. The range in crop conditions is represented by the same points. On the Yuma mesa there is a body of land destined to become famous for citrus and other tropical and subtropical fruits, where injurious frosts are unknown, while at Flagstaff, owing to the short growing season, deciduous fruit trees seldom succeed in setting and maturing a crop, sweet corn from the home garden is a rarity, and the staple crops are limited to Irish potatoes and small grains. In its crop limitations and possibilities, therefore, the state of Arizona may be said to be fairly representative of the entire United States, California being the only other state to be similarly situated.

The same conditions which influence crops exert a corresponding influence upon insect pests, more especially the native species. The species introduced from other sections are in addition influenced in their distribution by the isolated condition of our principal agricultural districts, the Lower Colorado or Yuma Valley, the Salt River Valley, the Gila Valley, the Verde Valley and the Little Colorado Valley. Each of these is isolated by hundreds of miles of desert, forests and ranges of mountains, while numerous smaller irrigation projects, sub-irrigated valleys and dry farm sections are scattered over the state. In general the favorable circumstances noted has not only greatly delayed and restricted the distribution of insect pests thus far introduced, but offers for the present and future the most favorable opportunities for the prevention of the introduction and spread of pests not yet occurring in the state.

Characteristic Insect Records. In outlining the entomological conditions of the state as personally observed and as brought to my attention through correspondence during the past three years, it is only proper to explain that owing to the large amount of time which has been required in the organization of an inspection service and in the administration of our inspection law under the hampering influence of inadequate funds, comparatively little time has been available for investigations and observations. With the more suitable provisions for assistance and equipment obtained by means of a recent amendment of the original law, known as the "Arizona Crop Pest Law of 1912," more rapid progress in these lines is assured. Considering the more important economic insects, grouped by orders regardless of the crops affected, the following notes and observations will characterize the entomological features and will show some of the entomological peculiarities of the state of Arizona.

Orthoptera. In common with most of the other Western states we have grasshopper problems; alfalfa, young citrus trees and beans

being the principal crops to suffer from these insects. What is perhaps the most interesting species occurs in southeastern Arizona where it is a serious pest of the bean and alfalfa crops. It is one of the "lubber" species (*Tænipoda picticornis*), locally known as the "Military grasshopper." It breeds in the desert and feeds upon mesquite until nearly full grown when it overruns cultivated fields, if any are near to the breeding grounds. A peculiarity of the species habits, affording a convenient means of control, is that the insects climb trees, fence posts and other objects at night, evidently for protection. This habit at once suggests a ready means for trapping the insects or for early morning collections by hand. As bearing upon this grasshoppers need for protection against natural enemies, suggested by the habit mentioned, it should be noted that this strikingly marked species is apparently unpalatable to turkeys.

Thysanoptera. The citrus thrips (*Euthrips citri*) is the only notable citrus pest known to occur at the present time in the state. Citrus nursery stock does not appear at all subject to injury by this insect in Arizona as it is in the San Joaquin Valley of California. During the past four seasons only about one fifth of the citrus groves have had fruit sufficiently scarred to warrant remedial measures, but this small proportion has suffered extensively. The average damage varies less from year to year than does the damage in individual groves. Without any remedial measures or changes in cultural methods, the grove most severely damaged in 1911 produced fruit in 1912 which was practically free from the characteristic surface scarring.

The flower or grain thrips (*Euthrips tritici*) appears to be more destructive to deciduous fruits in the Salt River Valley than in other sections of the country. An instance of injury unusual in its severity has been recorded and illustrated in my second report.[1] More or less local damage is occasioned by this pest each year. It seems probable that the abundance of the flower thrips in the Salt River Valley is due to the long breeding season and to the large acreage of alfalfa, in the blooms of which the insect thrives.

Hemiptera. In many parts of Arizona the blood sucking cone nose (*Conorhinus sanguisugus*) takes the place of the bed bug as a household pest. In the Salt River Valley it is supposed that the bed bug does not exist. This insect has, however, been forced upon my observation in the Verde Valley at an elevation of about 2,000 feet. The unquestionable thriftiness of the insect at the point where this observation was made confuses any attempt to explain the apparently complete absence of the pest in the older and far more densely populated Salt River Valley at elevations a little more than 1,000 feet. Is it

[1] Third Annual Report Arizona Horticultural Commission, pp. 21–23.

possible that this ubiquitous insect has after all so delicate a constitution that it is unable to exist in a place which has somewhat of a reputation as a human health resort?

The squash capsid (*Pycnoderes quadrimaculatus* Guen.) is an insect which as a pest appears peculiar to the Salt River Valley of Arizona. Late squashes, cassaba melons and beans are subject to serious damage by this pest which promises to be a difficult one to control. The common squash bug (*Anasa tristis*), as might be expected from its history in other sections of the country appears to thrive in this state at all elevations, where squashes are grown. It has been recorded at elevations of 1,100 and 5,300 feet near Phoenix and Prescott, respectively.

The western leaf-footed plant bug (*Leptoglossus zonatus*) prevents the development of pomegranate growing upon a commercial basis in the Salt River Valley. The improved varieties of this excellent fruit can find good markets when uninjured fruit can be obtained for shipment. The same plant bug sometimes attacks oranges in destructive numbers and in the Blue River Canyon of eastern Arizona, has been observed attacking ripening peaches. The growth of Egyptian cotton in the Yuma and Salt River Valleys promises to become one of the most profitable industries of the state, and it remains to be determined whether this pest will attack the green bolls of this variety as I have observed it to do in the case of upland cotton in the Laguna district of Mexico.[1]

Various species of aphids, particularly the melon louse (*Aphis gossypii*), the cabbage louse (*Aphis brassicæ*) and the woolly apple aphis (*Schizoneura lanigera*) are common and troublesome in Arizona.

The grape phylloxera (*P. vastatrix*) was discovered infesting the leaves of a species of a wild grape near Prescott, Arizona, in 1911. In August, 1912, in the same locality, three cultivated vines in a vineyard two or three acres in extent, were found to be infested. The indications are that the insect is a native of the section of the state where discovered. Professor Quaintance of the U. S. Department of Agriculture, who referred specimens to Mr. Pergande for determination, informs me that this is his first record of the occurrence of the grape phylloxera in Arizona. So far as observed the insects were confined to the leaves. Mr. R. L. Nougaret of the U. S. Department of Agriculture engaged in investigating the grape phylloxera in California under the direction of Mr. Quaintance writes that he has never observed the leaf infesting form in that state. In the upper Gila Valley, Arizona, at elevation from 2,500 to 3,000 feet and in the Salt River

[1] Bul. 54, Bureau of Entomology, U. S. Department of Agriculture.

Valley, at elevation 1,100 to 1,300 feet the grape phylloxera is as yet unknown.

Among leaf hoppers the best known economic species are the sugar beet leaf hopper (*Eutettix tenella*) occurring in the Salt River Valley where it is apparently a native, and two grape leaf hoppers (*Typhlocyba comes*), in the Gila Valley, and *Dicrancura cockerelli* in the Salt River Valley. In view of the scarcity of representatives of the family Aleyrodidæ in arid regions, it is of interest to note that the larvæ and pupæ of one apparently undescribed species of the genus Aleyrodes, frequently nearly completely cover the under surfaces of the leaves of its chief food plant, known as wild tobacco.

The scale insects of Arizona are very interesting but can only be touched upon in this paper. The San José scale was first recorded as present in the Salt River Valley nearly twenty-five years ago. So far as known this species is of no economic importance at present, since I have never found it in orchards in the state, nor has a single instance of injury by it been reported to my office. During the present year it is planned to secure more definite information concerning the status of this scale, and to determine if possible whether climatic conditions or parasites are responsible for its apparent inability to maintain itself injuriously in the state. The soft brown scale (*Lecanium hesperidum*) is notable in its occurrence in the Salt River Valley. Here it seems dependent upon the oleander, a very common ornamental, and rarely attacks the citrus, fig, china trees, pepper tree, rose or other food plants except when such are located near to an infested specimen of the preferred oleander. After the oleander is destroyed the colony gradually weakens and disappears. On this food plant the insect shows no preference for the shaded parts and in fact the young appear to settle by choice upon the upper surfaces of the leaves on the portions of the trees most exposed to the sun. In Florida the soft scale thrives on young citrus trees to the full extent permitted by its natural enemies, regardless of the existence of oleanders. During three years spent in Florida in white fly investigations numerous instances of temporary injury to young citrus trees by the soft scale were noted at Orlando and other points in that state, but this insect was never so abundant upon oleanders as to attract my attention. At my request, Mr. W. W. Yothers of the Bureau of Entomology, stationed at Orlando, has recently made a special examination of many oleanders in that city with the result that my impression concerning this matter is verified. Prof. H. J. Quayle recently writes that in California he has never observed any preference of the soft brown scale for the oleander over other food plants. The California red scale (*Chrysomphalus aurantii*) was discovered for the first time in

a citrus district in Arizona at Phoenix in June, 1912. Fortunately it was confined to one rose bush with the exception of a few specimens found on another rose a short distance away. A citrus tree fifty feet away and other roses of which there were a great many were apparently free from the insects. Prompt action was taken and it is believed that the colony was exterminated. The infested rose bush was brought to Phoenix from Pasadena, Cal., four years ago, before the inspection of imported plants was provided for. In 1912 when discovered the insects completely covered the larger branches of the bush. I am informed by Professor Quayle that in his observation citrus is the preferred food plant in California for the red scale. The condition as noted in Arizona is not an indication, as it might appear, that here the rose is the preferred food plant, since the insects had only recently spread to one of the nearby roses while many others scarcely farther away had been neglected as absolutely as had the citrus tree, so far as careful inspections could determine. Other scales which should be mentioned are the Parlatoria scale (*P. blanchardi*) and the Marlatt scale (*Phœniocococcus marlattii*) both of which attack the date palm. These scale insects, imported from Africa, have called into use the blast torch, an instrument which was privately exploited as an insect destroyer some years ago. The usefulness of this means for destroying the date palm scales, however, was demonstrated by Director Forbes of the Arizona Station in experiments conducted in 1905, 1906 and 1907.[1]

Lepidoptera. The corn ear worm (*Heliothis armigera*), codling moth (*Carpocapsa pomonella*), alfalfa butterfly (*Eurymus eurytheme*) and variegated cut worm (*Peridroma margaritosa saucia*) are about in the order named the leading pests of crops in Arizona among the lepidopterous insects. The marked preference of the larva of the variegated cut worm for alfalfa over other food plants, as exhibited in the Salt River Valley in 1911, was believed to be unusual. During the past season a similar striking preference was exhibited by the the same insect near Prescott and in the Little Colorado Valley, both instances being at elevations a little over 5,000 feet. In the case of the outbreak near Prescott, however, after the alfalfa was cut the capability of the worms for destroying garden crops was thoroughly demonstrated.

In Arizona the eastern grape leaf skeletonizer (*Harrisina americana*) is represented by related species (*H. coracina* and *H. metallica*). One species in the caterpillar stage differs from the eastern species by having cross bands consisting of blue dots but appears to have feeding habits which are identical with its eastern relative.

[1] Bul. 56, Arizona Exp. Sta. pp. 199–203, (1907).

The discovery of the Eastern peach tree borer (*Sanninoidea exitiosa*) in two sections of Arizona has been noted in two publications of the Arizona Horticultural Commisssion.[1] Where observed the injury was severe owing to the failure of the owners of the infested trees to recognize the presence of the insects. It is strangely fortunate that the insect has never been found or borer injury reported from any of the important fruit growing sections of the state. I was informed by Dr. C. P. Gillette several months ago that a similar situation existed in Colorado.

Coleoptera. As a substitute for the Eastern rose chafer (*Macrodactylus subspinosus*) Arizona has a western form of the same genus (*M. uniformis*) with similar habits.[2] Instead of the fig eater (*Allorhina nitida*) which is so common in the southeastern United States, Arizona has a substitute in the misnamed "green June beetle" (*Allorhina mutabilis*) which has a far more destructive appetite. Peaches and figs are badly and generally injured by these beetles wherever grown in the state. Apples were observed to be seriously attacked in one instance in eastern Arizona at Thatcher, but this visitation is believed to have been principally due to the scarcity of fruit in the peach orchards. The ripening fruit of the date palm is attractive to several insects and among these a small nitidulid beetle (*Carpophilus dimidiatus*) heretofore considered harmless, has been found to be a serious enemy, breeding in this fruit in enormous numbers. Possibly this is the first record of a member of this family being of economic interest. Notwithstanding the impression frequently expressed to the effect that the Colorado potato beetle (*Doryphora decimlineata*) exists in the United States wherever Irish potatoes are grown, this pest is of only limited distribution in Arizona. It is well established and moderately injurious near Prescott at elevations slightly over 5,300 feet and infests only a small percentage of the farms near Williams and Flagstaff, at elevations near to 7,000 feet, where the principal potato growing section of the state is located. Of more importance than the Colorado potato beetle as enemies of potatoes in Arizona are three blister beetles which owing to a mishap have not been determined specifically.

The bean lady bug (*Epilachna corrupta*) is one of the most destructive beetles in Arizona. This has been observed or authoritatively reported from Thatcher, Clifton, McNeil, Prescott and Taylor, representing elevations from 2500 to 5500 feet. It is unknown in the Salt River Valley.

Diptera. The typhoid or house fly is as undescribably numerous

[1] Circular 16, p. 23, 1911 and Fourth Annual Report, p. 31 (1912).

[2] Third Annual Report Arizona Horticultural Commission, pp. 23–24.

and offensive in Arizona as it is in the average state. In the section of the state where typhoid fever is most prevalent, there is rather strong evidence that this insect and not the water supply is largely responsible for the spread of the disease. The same insect is no doubt an important agent in the spread of trachoma, an eye disease which is particularly prevalent among the Indians.

The alfalfa gall midge (*Asphondylia miki*) originally described from Europe and reported by Professor Webster[1] during the past year as occurring in Salt River Valley and vicinity has thus far proven of but little economic importance in Arizona. Characteristic galled seed pods were discovered in the northeastern part of the state at St. Johns in September, 1911, and in September, 1912, at Holbrook. Both of these occurrences are so isolated as to almost preclude the possibility of artificial introduction. At Holbrook there is no farming done and the infested pods were on a few volunteer alfalfa plants. It seems safe to predict that a wild food plant will eventually be found in Arizona.

Hymenoptera. In this order Arizona has three pests of high rank in the clover seed chalcis (*Bruchophagus funebris*), the harvester ant (*Pogonomyrmex barbata* vars) and leaf cutter bees, of possibly more than one species. The clover seed chalcis not only causes a direct loss to alfalfa seed growers in Arizona of more than $100,000 per year, but dissipates the hopes for the development of the seed producing industry which the state is peculiarly suited for climatically, until some satisfactory method of avoiding the injury is worked out. The past year was marked by a still further decline in alfalfa seed production in the Buckeye Valley, which as a new district became noted for its alfalfa seed several years ago.

The harvester ants are responsible for the large and numerous bare spots which are found in the alfalfa grain fields, particularly in the Salt River Valley. In this connection a use for London Purple not generally known to entomologists should be noted. This poison owing to its fine state of pulverization seems especially adapted for placing around the entrance of the nests of the ants where it may adhere to the feet of the insects and be carried into the nests to poison the food supply. I have been unable to obtain any early history of the use of London Purple in this manner. Sometimes ineffective lots may be obtained. Two years ago analyses were made of a series of samples which represented, as shown by thorough field tests, various degrees of effectiveness.[2] It was my expectation that the analyses would provide a chemical basis for selecting grades of London Purple

[1] Circular 147, Bureau of Entomology, U. S. Department of Agriculture, (1912).
[2] Twenty-first Annual Report Arizona Horticultural Experiment Station, p. 391.

which were suitable for use against ants. The results were disappointing and perplexing, no relation being shown between the amount of arsenic present and the results secured by field tests. Whether a mechanical basis can be discovered for the object mentioned remains to be determined.

Leaf cutting bees are the cause of much damage to young fruit trees in southern and eastern Arizona. In the Salt River Valley roses appear to be the only plant subject to injury. Specimens of the species concerned have not been captured by myself or by my correspondents with the exception of a single specimen which reached me in a broken condition.

Entomology and the Arizona Public. The foregoing records which purport to be merely a general characterization of the economic insect fauna of Arizona indicate the extent of the field now open for work in that state. While we are still fortunately free, as far as known, from many of the most destructive insect pests of the country, there is no scarcity of native insects with predilections for cultivated crops.

The need for entomological protection and entomological investigations is being more and more generally recognized in the state. In 1909 the first appropriation of $3,000 per annum for entomological work was made in the territorial assembly after a hard fight for recognition by the interests most concerned. In 1912, with urgent necessity for economy in all appropriations, the state legislature by a unanimous vote in both houses passed a bill amending the original law and adding $9,000 a year to the original amount. The outlook for future accomplishment in economic entomology in Arizona is most promising and the continued favorable attitude of the public is hopefully anticipated.

President W. D. Hunter: Two of the most striking entomological observations made on a recent trip in the arid southwest dealt with the house fly and mosquitoes. One would not naturally expect to find an abundance of these insects in such a region. Artificial circumstances tend to overcome natural obstacles in the breeding of these insects. The water used for irrigation allows the mosquitoes to breed in great numbers and carelessness about the disposal of garbage allows great numbers of house flies to be bred.

We will now listen to a paper by Mr. S. J. Hunter on "Apparatus for Maintenance of Thermal Climatic Conditions."

APPARATUS FOR MAINTENANCE OF THERMAL CLIMATIC CONDITIONS

By S. J. Hunter, *Lawrence, Kans.*

[A summary of this paper appears in the discussion below.—*Ed.*]

President W. D. Hunter: Any discussion?

Mr. T. J. Headlee: I am very much interested in this subject and should be glad to have the speaker explain the following points: 1st, whether the temperature maintained is supposed to be a constant one, or whether it is intended to show a diurnal variation; 2d, the exact source, nature, measurement or control of the light; 3d, the control of atmospheric moisture.

Mr. S. J. Hunter: This temperature control apparatus (plates 5, 6) is constructed to fulfil our specific requirements. I do not undertake to say that it will fulfil hypothetical conditions arbitrarily imposed. The chamber is 5′x 5′x 8′, double glass lined on four sides. The temperature is controlled by an ammonia compressor, while the power is furnished by a ¾-H.P. D.C. motor. Sunlight can be admitted from the south and west or excluded as desired, leaving daylight from the north. We can maintain constants or variables from 60° above to 10° below zero F. Standard constant conditions are easier to maintain than the establishment of given curves of variation. Constants do not occur in nature; hence, for the present with these we are not concerned. Standard weather guages keep the records. The purpose of this apparatus is to interpret the influence of temperature and moisture as natural climatic conditions on growth and development. The climatic data is taken from our climatic records, continuously observed since 1868.

Mr. T. J. Headlee: How does the speaker plan to control or determine the relative proportion of gases in the air?

Mr. S. J. Hunter: Ventilation can readily be secured and normal conditions of surrounding atmosphere maintained through ventilators aided by electric fans. The moisture content can be controlled by chloride of lime filtration.

Mr. T. J. Headlee: In the study of the effects of temperature and moisture on the rate of insect metabolism I have not found it possible to control the intensity of the light. The difference in the results obtained from experiments conducted under the same temperature and moisture and under practically the same food and gas conditions at different times of the year are difficult to account for so long as the intensity of the light is an unknown factor. In fact, it is possible that the ascribing of a difference in response obtained

Apparatus for Maintenance of Thermal Climatic Conditions. Maintains Normal Down to 10° Below Zero *F*. University of Kansas, Lawrence, Kansas.

APPARATUS FOR MAINTENANCE OF THERMAL CLIMATIC CONDITIONS. MAINTAINS NORMAL DOWN TO 10° BELOW ZERO *F.* UNIVERSITY OF KANSAS, Lawrence, Kansas.

from organisms under different temperature conditions; but under similar moisture, food and gas conditions conducted at different times of the year to the measured difference in temperature is hardly justifiable. I regard the control of the sunlight variable as the most difficult of all the climatic variables in this sort of study.

Mr. E. P. Felt: I want to call attention to an apparatus which might be useful to entomologists along this line, and that is a very efficient device for maintaining low temperature. It is simply a series of furnace pipes passing through the ordinary type of cold chamber and packed with ice and salt. One or more pipes may be used and by varying the relative amount of salt and ice considerable modification in the temperature may be obtained.

Mr. E. C. Cotton: Regarding the question of sunlight I think that for most experiments it is not an important factor. If it is, one can darken the room and use artificial light. With an arc light using carbons impregnated with certain chemicals we can closely simulate daylight. In regard to Dr. Felt's suggestion I think that we are making a mistake by attempting to cool the air by means of pipes within the room itself. It is impossible to hold the temperature constant with cooling pipes of any kind in the room because of residual cooling from the cold mass of metal after the absorbing agent (brine or expanding gas) has been shut off. I believe that it is necessary to cool or heat the air outside of the room using a thermo-regulator to determine when and what kind shall be introduced. I find in our work that an electric regulator is out of the question, the regulator we are using depends upon the expansion of gases.

President Hunter: The next paper will be presented by Dr. Britton.

RECENT STUDIES ON THE WEEVIL AND THE BUD MOTH OF THE WALNUT AND A SAWFLY ATTACKING BLACKBERRY

By W. E. Britton, *State Entomologist, New Haven, Conn.*

Attempts to grow the English or Persian Walnut, *Juglans regia*, as well as certain other species of *Juglans* in Connecticut have almost failed, largely because of two insects which attack the trees, the walnut weevil or curculio, *Conotrachelus juglandis* Lec., and a bud moth belonging to the genus *Acrobasis* and probably referable to the species *caryæ* Grote.

Studies of the life histories and habits and of the injuries caused by these two pests, were made during the past summer on the farm of Dr. Robert T. Morris at Stamford and the walnut weevil was also

studied on the grounds of Mr. H. L. Champlain at Lyme. Most of the field work was done by my assistant Mr. H. B. Kirk.

In nearly all of the references to the walnut weevil in a somewhat scanty literature, this insect is said to breed in the nuts, but in Connecticut the larvæ do great damage by tunneling in the new shoots. In most cases infested trees produce little fruit as the shoots soon wither and die.

There is but one generation each year and the overwintering adults appear the latter part of May and feed upon the stems and leaf-veins. About the last week in May the females begin to lay eggs in the stems in irregular crescent-chaped punctures under flaps, like those of the plum curculio. The egg-laying period continues until the first of August, and after the nuts have formed some eggs are laid in them. The eggs require from six to twelve days for hatching, depending probably upon the weather. The larvæ tunnel in the stems of the shoots usually working upward, though going in both directions, and the frass is thrown out laterally through the egg punctures. From four to six weeks are necessary for larval development which ceases in the stems about September 1, and larvæ hatching from eggs laid after about July 20 do not mature. In the fruit the larvæ feed in the kernels but return to the shucks to finish their development. When mature, they go an inch into the ground and pupate about ten days later. The adult beetles emerge from sixteen to twenty days after pupating, fly to the trees and eat holes at the base of the leaf petioles.

In Connecticut the species of walnuts (*Juglans*) are attacked and injured in the following order, those first named being the most damaged: *cordiformis, sieboldiana, cinerea, regia, mandshurica, nigra.*

Our limited tests indicate that this insect may be controlled by spraying with lead arsenate in the usual proportions. Probably two applications should be given,—the first about May 20 in Connecticut, and directed against the under side of the leaves; and the second three or four weeks later.

The walnut weevil occurs in Quebec and Ontario, Canada, and southward to the Gulf of Mexico, and at least as far west as Texas, Kansas, Nebraska, Iowa and Wisconsin.

The bud moth evidently prefers *Juglans regia*, but also attacks and injures *cinerea* and *nigra*. There are three generations each season. The eggs are laid singly at the base of the bud about the second week in May for the first brood, July 1 for the second brood and August 15 for the third brood. They hatch in from six to ten days. Nearly four weeks are required for the larvæ to become mature, when they pupate in the stems and adults emerge from two to three weeks later. Sometimes the larva feeds upon the exterior and perhaps wholly on

one side of the stem, but usually it tunnels downward from the terminal or from an axillary bud being concealed all the while.

The frass is retained at the entrance of the burrow and being fastened to leaves, helps to form the nest where pupation occurs, and which is the most conspicuous evidence of the presence of the bud moth. The frass is never exuded laterally from the burrow as is the case with the walnut weevil.

The bud moth does about as much damage to the Persian walnut as does the weevil, and like that species can be controlled by spraying with lead arsenate. In fact, the same treatment is effective against both insects. Probably the winter is passed in the larval stage, though this point is not settled.

The bud moth may prove to be *Acrobasis caryæ* Grote or a new species.

Early in the summer of 1910 my assistant, Mr. B. H. Walden, collected in a blackberry plantation near New Haven some adult saw-flies which Dr. A. D. MacGillivray pronounced a new species. In 1911, he noticed that some of the plants in the same field had been defoliated by saw-fly larvæ, but no adults were reared that season. In 1912, additional material was gathered and the adults reared from the larvæ proved to be identical with those collected in the same field two years before and were described by Dr. MacGillivray in the *Canadian Entomologist* Vol. XLIV, October, 1912, page 297, as *Pamphilius dentatus*.

The eggs are laid in rows on the leaf-veins the first part of June. The eggs soon hatch and from fourteen to seventeen days are necessary for the larvæ to reach maturity, when they go into the ground and remain until the following spring before pupating. The adults appear the latter half of May. The larvæ spin threads by means of which they draw a portion of the leaf over themselves forming a protecting tube in which they feed. One tube may serve as a nest for several larvæ or it may contain a single occupant. The habits are quite similar to those of the peach saw-fly, *Pamphilius persicum* MacG. studied by Mr. Walden in 1907.

Detailed accounts of these studies together with such other facts as are known about the walnut weevil, walnut bud moth and the blackberry saw-fly, may be found in the twelfth Report of the State Entomologist of Connecticut, which is Part III of the Annual Report of the Agricultural Experiment Station for 1912.

At the conclusion of this paper the business session was resumed, after which the meeting adjourned.

The following papers were read by title and in accordance with the practice of earlier years are included in the printed proceedings.

ADDITIONAL NOTES ON THE BIOLOGY OF THE ROCKY MOUNTAIN SPOTTED-FEVER TICK[1]

By F. C. Bishopp and W. V. King

The Rocky Mountain spotted fever problem is becoming familiar to most entomologists, although until the last few years it was generally considered a medical problem. The splendid work of the late Dr. H. T. Ricketts during 1906 and the three succeeding years, which clearly showed that the tick, *Dermacentor venustus*, is the carrier of the disease, greatly stimulated the interest of entomologists in this field. As was first indicated by Dr. Ricketts[2] and later clearly outlined as a result of investigations conducted by the Bureau of Entomology[3] in coöperation with the Montana Experiment Station,[4] the combatting of the disease resolves itself into a fight against the transmitting agent.

The problem should not be considered a local one. In the Bitter Root Valley in Montana, where the disease occurs in its most virulent form, from 70 to 80 per cent of the ten to twenty cases which occur there annually result fatally. In Idaho alone, at least 375 cases occur each year, according to Dr. E. E. Maxey. The death rate in Idaho is much lower but the slow recovery of many of the patients adds materially to the economic loss. Hunter and Bishopp have estimated the total number of cases which occur annually in the United States at 750 with seventy-five deaths. The disease is not prevalent throughout all of the tick-infested territory but is known to occur in Alaska, Washington, Oregon, California, Nevada, Utah, Wyoming and Colorado in addition to Montana and Idaho, and it probably occurs also in British Columbia.

The authors desire to acknowledge the helpful suggestions of Mr. W. D. Hunter and Prof. R. A. Cooley under the general direction of whom this work has been done. Professor Cooley is responsible for the observations made on longevity in the Bitter Root Valley during the spring of 1912. The assistance of Mr. H. P. Wood in conducting experiments and making observations at Dallas, Texas, is also gratefully acknowledged.

Seasonal Activity of Adults

Since the adult tick is with rare exceptions the only stage which attacks man and since the most feasible control measures consist of

[1] Published by permission of the Chief of the Bureau of Entomology.

[2] Spotted fever report Nos. 1 and 2—4th Bien. Rept. St. Bd. Health, Montana, pp. 87–191, 1909.

[3] W. D. Hunter and F. C. Bishopp—The Rocky Mountain Spotted Fever Tick—Bull. 105, Bur. of Ent., U. S. Dept. Agr., 1911.

[4] R. A. Cooley—Tick control in relation to the Rocky Mountain spotted fever—Bull. 85, Mont. Exp. Sta., 1911.

the destruction of the adult ticks on the domestic animals, the determination of the period of activity of this stage is of importance. The first appearance of the adults occurs shortly after the first warm days of early spring. The date of appearance varies somewhat according to the latitude, altitude, and, in a given locality, the climatic conditions, particularly the temperature, have their influence. One of the present authors (King) determined rather accurately the date of first appearance of adults in the Bitter Root Valley in 1910 and 1911. March 11 and March 15, respectively, were the dates when the first ticks were found during these years. The mean temperature at Missoula, Mont., which is located near the mouth of the Bitter Root Valley, was 43°F. or 8.2°F. above normal during March, 1910, and 39°F. or 4.1°F. above normal during March, 1911. The minimum temperature during March, 1910, was 21°F., while a minimum of 0°F. was reached in March, 1911. At Hamilton, Mont., which is in the center of the valley, the mean temperature for March, 1910, was 46.8°F. and for March, 1911, was 41.9°F. The much warmer March experienced in 1910 than in 1911 no doubt explains the slightly earlier appearance of ticks in 1910 than in 1911. We may also conclude that the appearance of adults at a date earlier than March 11 must be extremely rare as the winter of 1909–10 was not more severe than usual and the March temperatures were much warmer than normal.

At Rifle, Colorado, in 1910, ticks appeared shortly before March 23, while in 1911 they appeared between March 3 and March 14. The temperature was considerably higher during the latter part of February and during early March of the latter year. During 1911 the first appearance of adults was recorded in a number of different sections as follows: Round Mountain, Nevada, about March 8; Viewpoint, Oregon, March 10; Weatherby, Oregon, March 14; Vernon, Idaho, March 27; Buford, Wyo., about April 1.

It appears that the zero of effective temperature of this species is not far from 35°F. It is certain that this point is considerably lower than in the case of insects and ticks which occur in southern latitudes. The accumulated effective temperature (computed in daily units of mean temperature) necessary to produce emergence from hibernation is low, apparently being in the neighborhood of 37° F. Adults may be expected to begin emerging within six to twelve days when the daily mean ranges between 38°F. and 42°F. for several consecutive days. The data at hand indicate that there is no active period between the semi-active summer or æstivation period and hibernation. The temperature at which dormancy is produced in the fall seems to be about 10°F. to 15°F. higher than that producing emergence from hiber-

nation in the spring. The question of the relation of climate to this tick will be treated more fully in a subsequent paper.

The date of the disappearance of adults is much more variable than is the time of beginning emergence from hibernation. The greatest abundance of adults occurs during April and May. During June the number rapidly diminishes so that by the first of July very few specimens are to be seen attached to hosts. During the warm summer days, especially toward the latter part of summer, the adults begin leaving the plants upon which they rest while awaiting hosts, and crawl down beneath the grass and leaves. These ticks may be aroused and will occasionally attach, although after August 1 they seem extremely reluctant about feeding and endeavor to escape from the host when applied. In about thirty tests of attachment made after August 15, in but three cases were specimens induced to attach to hosts, and none of these engorged or copulated.

At high altitudes the activity of adults is continued to a later date in summer than at lower ones. For instance, at Virginia Dale, Colorado (altitude 7,200 ft.) on June 24–25, 1910, a considerable number of ticks, some of which were well engorged, were taken on horses and cattle, while at altitudes of 5,300 feet no specimens were to be found on hosts. A similar condition was observed in the Bitter Root Valley on July 9, 1911, when numerous unengorged adults were found on our clothing above Lake Como at an altitude of from 5,500 to 6,500 feet, while in the Valley proper at an altitude of 3,000 to 4,000 feet very few specimens were seen.

The last adults observed during the investigations of 1910 in the Bitter Root Valley were seen on hosts July 16. In 1911 straggling adults were active to a much later date, the last being observed on August 21. This difference may be accounted for by the much warmer weather which occurred from March to July, 1910. The mean temperature during each month of this period was from 2°F. to 8.2°F. above normal, making a total accumulated temperature above the normal of 24.2°F., while in 1911 the mean temperature from March to July was exactly normal, July being below normal.

In 1911 the last adults were seen on the following dates at the different points: Florence, Mont., August 21; Darby, Mont., July 9 (no subsequent examinations); Viewpoint, Oregon, September 25; White Pine, Mont., September 31 (no subsequent examination). In 1912 the last adults were seen at Virginia Dale, Colo., August 31 and at Viewpoint, Oregon, September 9. The late occurrence of adults at Viewpoint, Oregon, may be due to the comparatively low mean temperature during the summer months, as well as the absence of very high maxima.

As has been indicated in the foregoing statements, and previously discussed in other articles,[1,2] the greatest activity of adults occurs in the spring and early summer. This is especially true in regard to their feeding. This spring feeding habit is not only shown by adults which mature in the early part of the season, but also by those individuals which hibernate as adults having molted from nymphs the previous season. While the former class of individuals does not show any desire to feed during the summer or fall, those individuals which have hibernated show a tendency to remain active later in the summer. This habit has been observed in large cage experiments in the Bitter Root Valley as well as in cages at Dallas, Texas. It was formerly supposed by many that the factor which limited the season of adult activity to the spring and early summer months was that the over-wintering adults either obtained hosts or died before about July 1. This is not true, as we have found hibernated adults to pass to the ground in July and remain inactive till the following spring when they again appeared for feeding. During the past summer, at Viewpoint, Oregon, Mr. H. H. Hatch, who kept careful watch on the activity of ticks, observed them to become very scarce the last of June and remain so throughout the summer. In September, however, a slightly greater number of adults was found. Throughout this period no individuals more than one-half engorged were observed on hosts.

Distribution and Hosts

Little additional information has been secured on the general distribution of this species since the publication of articles on this subject by Bishopp[3] and by Hunter and Bishopp.[4] Our knowledge of the extent of infested territory in California has been increased by the receipt of specimens from Madeline, Lassen County.

The host relations of this tick have been discussed in a number of publications. As has been pointed out by Hunter and Bishopp,[5] the mountain goat serves as a host for a considerable number of the adults of this species. Immature stages may also develop on this animal. However, it has been found that a number of small mammals occur on the mountains inhabited by the goats and act as host for the immature stages. The question of the mountain goat acting as a

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[1]Hooker, W. A., Bishopp, F. C. and Wood, H. P.—The life history and bionomics of some North American ticks—Bull. 106, Bur. of Ent., U. S. Dept. Agr., 1912, p. 178.

[2]Bull. 105, Bur. of Ent., U. S. Dept. Agr., 1911, p. 26.

[3]Bishopp, F. C.—The distribution of the Rocky Mountain spotted-fever tick—Cir. 136, Bur. of Ent., U. S. Dept. Agr., 1911, p. 4.

[4]Bull. 105, Bur. of Ent., U. S. Dept. Agr., 1911, pp. 15-17.

[5]Bull. 105, Bur. of Ent., U. S. Dept. Agr., 1911, pp. 28-29.

reservoir for Rocky Mountain spotted fever has been much discussed by most of the investigators who have been carrying on work in the Bitter Root Valley. The recent discovery, reported by Rucker,[1] of an infected tick on the mountain goat is of much interest. As is commonly known, the disease occurs mainly on the western side of the Bitter Root Valley. On this side the mountains ascend abruptly from the floor of the valley and thus furnish a suitable habitat for the mountain goat. The goats do not come into the Valley proper but during the winter frequent the more precipitous portions of the mountains immediately adjoining the Valley at a number of points along the western side. With the possibility that the mountain goat is a natural reservoir for the disease virus, infected ticks in the immature stages may be carried by small wild animals from the higher altitudes to the lower regions where native cattle graze. The habit of the goats of retreating into higher elevations as the season advances would minimize this danger, however.

A very few angora goats are kept by residents on the west side of the Valley. Although we have found that this animal may act as a host for adults of the spotted-fever tick, there is not sufficient evidence at hand to warrant any statement regarding the possibility of this animal being susceptible to spotted fever.

Hibernation

Investigations in the Northwest during 1910 and 1911 indicated that hibernation takes place only in the nymphal and adult stages. During the winter of 1911, however, this idea was proven to be fallacious. Out of a total of about forty-five lots of seed ticks which hatched from eggs during the summer and fall of 1911, a considerable number in thirty-two lots was found to be alive and active in the spring of 1912, thus proving that it is possible for large numbers of the tick to hibernate in the larval stage.

A number of nymphs which were engorged by one of the authors (King) during the summer of 1910 did not transform to adults until the following summer, thus showing that it is also possible for the tick to pass the winter in the engorged nymphal stage. Under natural conditions it appears that the majority of the nymphs which drop from hosts before August 15 molt to adults and hibernate in that stage. The examination of a large number of hosts of the immature stages in several localities shows that very few nymphs are to be found on them after August 15, thus indicating that few ticks enter the winter in the engorged nymphal stage.

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[1]Rucker, W. C.—Rocky Mountain spotted fever. Public Health Reports, Vol. XXVII, No. 36, 1912, p. 14.

It has been supposed that different stages of ticks are probably carried into the winter quarters of ground squirrels and other animals. There seems little doubt that a few larvæ and nymphs are still attached when the animals enter hibernation. Other species of ticks have been found in considerable numbers in burrows of animals during the summer and in one instance Mr. C. Birdseye found a two-thirds engorged female of *Ixodes æqualis* Banks in an underground nest of *Citellus beecheyi* on February 25, 1911, at Modesta, Cal. With a view of determining if specimens of the spotted-fever tick are to be found in the winter nests of ground squirrels, one of the authors (King) had a number of squirrel burrows dug up during the first part of October 1910, about one and one-half months after the time of hibernation. No hibernating squirrels were found but forty nests (probably summer nests and containing live mites and fleas) were secured and immediately placed in tick proof sacks. The contents of twelve of these nests were thoroughly examined and the sacks containing all the nests were searched without finding any ticks. Two other nests which had undoubtedly contained hibernating squirrels a few days previous and which were found by following fresh badger diggings were also examined with the same negative result. For comparison with this several quarts of trash from around the entrance of one burrow was sacked on September 26. By searching only the top of the sack two adults and four nymphal ticks, which had crawled from the trash, were found.

Life History

Records made by one of the authors (King) in the Bitter Root Valley present some variations, from those published heretofore, in the longevity and the developmental periods of different stages of this tick. A few of the records are here given. The greatest longevity of larvæ previously recorded was 117 days. This record was made in 1910. Larvæ hatched in July and August, 1911, went through the winter, and in a number of lots were still alive when last observed on June 11, 1912. On May 16, 1912, some of these were taken from the outdoor tubes in which they were kept and sent to Dallas by Professor Cooley. These attached and engorged readily when applied to guinea pigs at Dallas, Texas, on May 22. The maximum longevity in these lots exceeded 317 days. It was observed that some larvæ had died before the advent of cold weather in the fall of 1911.

The first two and the last records given in the following table were made on ticks kept in glass cylinders with gauze tops and kept out of doors in partial shade. The third record was made on ticks kept in the same kind of container but in the open field. The other three lots were

kept in pill boxes in a building; the eggs being separated and placed in test tubes in partial shade out of doors on July 14.

TABLE I—PRE-OVIPOSITION, DEPOSITION, INCUBATION AND LARVAL LONGEVITY

Date ♀ dropped	Date deposition began	Pre-oviposition period	Deposition complete	Deposition period	Hatching began	Incubation period	All larvæ dead	Larval longevity
1911	1911	Days	1911	Days	1911	Days		Days
April 14	June 12	59	July 15	33	Aug. 17	66	Oct. 16, 1911–April 10, 1912	60–237
April 14	June 12	59	Aug. 7±	56±	Aug. 24	73	June 11, 1912, many alive	292+
April 29	May 30	31	....	....	July 1	31	Sept. 1, 1911	31
April 29	June 8±	40±	July 24	46±	July 26	48±	June 7, 1912, 200 alive	317+
May 11	June 8±	28	July 23	45±	Aug. 6	59±	April 16, 1912, many alive	248+
May 31	June 27	27	July 23	26	Aug. 10	44	April 10, 1912, many alive	244+
June 19	July 9±*	20	....	....	Sept. 7	57	June 11, 1912, many alive	278+

* The first viable eggs were deposited July 12.

Recent records on the engorgement of larvæ show no marked deviation from those already published. The shortest engorgement period noted was forty-seven hours.

The shortest period from dropping to molting of larvæ observed in 1911 was fifteen days, while in 1910, owing to higher temperature, some molted in eleven days. The longest molting period was thirty-one days. This record was made on larvæ which dropped from a ground squirrel August 30, 1911.

An interesting record of the longevity of unengorged nymphs was made in 1910–11. A lot of thirteen nymphs which emerged July 25, 1910, were kept in a small vial covered with gauze in a shed in the Bitter Root Valley. On March 14, 1911, all were alive; July 23, ten were alive and active; August 1, four were alive, one being weak, and all were dead August 7. The last survivors had lived one year and eleven days without food. Several other lots lived almost a year.

As has been mentioned, a lot of engorged nymphs survived the winter of 1910–11. These were engorged between August 22 and September 11. Although kept under rather unnatural conditions, a number of abnormal adults emerged during March, 1911, and twenty-six males and seventeen females, all of which were normal, emerged between July 26 and August 18, 1911. The maximum period from dropping to molting in this series was eleven months and nineteen days. In a large number of records on the molting period of nymphs made in the Bitter Root Valley by one of the authors (King) in 1911, nymphs which dropped, engorged, in April molted from eighty-three to between 130 and 140 days later. Those dropped in May molted within seventy-three to ninety-nine days; those dropped in June molted within thirty-nine to sixty-four days; those dropped in July molted within twenty-nine to sixty-one days, and those dropped in August molted within twenty-seven to thirty-one days. All nymphs which were engorged by us in the Bitter Root Valley during 1911 molted before the coming of cold weather, except a single specimen which was collected on July 4. This had not transformed by October 16 and was not observed afterward. At Dallas, Texas, however, in a lot of nymphs which dropped from a host October 3–6, 1911, three molted to adults the following year. One of these (a male) emerged on May 6, and two (a male and female) emerged shortly before June 8. One nymph in this lot transformed to a male on October 30, 1911, and the others died during the winter. One of those which died remained active for 103 days and another for 136 days after dropping from the host thus showing that transformation proceeded very slowly.

As is to be expected, the longevity of adults is greater in the Bitter Root Valley and other parts of the Northwest where the tick occurs under more natural conditions than at Dallas, Texas, where many of the previously published records on longevity have been made. A series of tests made by one of the authors (King) in the Bitter Root

Valley show that the adults of this tick are capable of a longevity greater than 641 days. This record was made on a lot containing eight males and two females which emerged from the nymphal stage July 9–10, 1910. All of the ticks were alive August 10, 1910, when four males were removed. The remaining four males and two females were still alive April 10, 1912, when the last observation was made. A single male, in another lot containing six males and ten females, which became adult on July 18–19, 1910, was alive on April 10, 1912, when last observed. In another lot consisting of eight females, seven were still alive on the date of last observance, April 10, 1912. In each of the last two lots the longevity exceeded 632 days. In a large series of tests at Dallas, Texas, of adults which molted from nymphs during 1910 and 1911 the longevity of many specimens ranged from nine to fifteen months. It has been found that adults which were collected in Montana in the spring readily attached and became engorged the following spring. These individuals undoubtedly hibernated as adults and were therefore a year and six or seven months old.

Life Cycle

The question of the time required for this tick to complete its life cycle has been considerably discussed. It was thought that one generation developed annually. However, the investigations conducted by the Bureau of Entomology in coöperation with the Montana Experiment Station early indicated that this is not the normal cycle. As pointed out by Cooley[1] and more fully discussed by Hunter and Bishopp,[2] the life cycle often, if not usually, requires two years for its completion. More recently Rucker[3] has made the statement that "Additional experimental evidence seems needful to prove this." The question is not if the life cycle sometimes requires two years, but is it ever completed in one year? In other words, the two-year life cycle is the usual, if not the only course followed by the tick in the Bitter Root Valley. Since it has been proved conclusively by experimentation that adults will not under natural conditions become engorged during the same season in which they transform to that stage, there is no likelihood of the completion of a cycle developing from overwintered nymphs. The same habit prevents the completion of a generation from overwintered larvæ as well as from individuals which may pass the winter as engorged nymphs.

A study of the data on the number of nymphs present on various

[1]Bull. 85, Mont. Exp. Sta., 1911, p. 25.

[2]Bull. 105, Bur. of Ent. U. S. Dept. Agr., 1911, pp. 23–27.

[3]Public Health Repts., Vol. XXVII, No. 36, 1912, p. 13.

host animals examined in 1910–11 in the Bitter Root Valley throws much light on the question of the possibility of a cycle being completed in one year, from overwintered unengorged adults. During 1910, from March 26 to June 30, 393 animals which act as hosts for nymphs were examined and a total of 907 nymphs found, or an average of 2.3 nymphs per animal. From July 1 to August 17 of that year 180 nymph-bearing animals were examined, a total of 300 nymphs being found, or an average of 1.6 per animal. From August 18 to October 14, 127 nymph-bearing animals were examined on which ten nymphs were found, or an average of .07 per animal. During 1911, from April 1 to June 30, 149 nymph-bearing animals were examined upon which 651 nymphs were found, or an average of 4.37 per animal. From July 1 to August 17, fifty-four nymphs were found upon the 129 nymphal hosts examined, or .42 per animal. From August 17 to October 1, one nymph was found on the 33 nymphal hosts examined, or an average of .03 per animal. Supposing these figures to represent the true percentage, it will be seen that 74 per cent of the nymphs which developed during the season of 1910 were to be found on animals prior to July 1, and during 1911, 95 per cent of total development took place prior to that date.

The following will show the bearing of these figures on the life cycle question. In 1910 the first larvæ were taken on hosts on June 13. This was an exceptionally warm season and the appearance of larvæ was probably from one to two weeks earlier than normal. In 1911, a more nearly normal season, the first larvæ were found on July 9. Allowing the shortest possible time for engorgement and molting of the larvæ and the hardening of the resulting nymphs, the date of appearance of the first nymphs of that generation on hosts would be some time after July 1. From this time on, as has been stated, there are very few nymphs on hosts: just at a time when one would expect a heavy infestation, provided it was a normal habit for nymphs developed from overwintered adults to attach the same year. It has also been determined that unengorged nymphs emerging during the fall of one year may live till August 18 of the following year. Hence it is reasonable to suppose that the majority of the few nymphs found on hosts after July 1 are straggling individuals from those which hibernated as unengorged nymphs the previous winter.

August 17 is used as the last date in the second period because of the fact that by this date the principal hosts, the ground squirrel, *Citellus columbianus*, and woodchuck, *Marmota flaviventer*, have gone into hibernation. Then, too, as has been stated, a lot of sixty-seven nymphs which had been placed on hosts on August 17–18, 1910, did not transform to adults till the following summer, hence requiring

more than one year for completing the cycle. It has also been found that nymphs show less inclination to attach to hosts as the temperature declines in the fall.

It must be concluded, therefore, that the possibility of the completion of a cycle in one season is very remote in the Bitter Root Valley. In the more southern range of the tick there is more likelihood of some ticks, which hibernate as adults, being able to complete the cycle in one season. It should also be pointed out that at the rate of development which has been observed in the Bitter Root Valley, it is easily possible for ticks to take three years to complete a cycle.

Results of Tick Attack on Man (Other than Spotted-fever)

A considerable number of curious cases of paralysis, more or less complete and in some cases fatal, have been reported as being produced by *Dermacentor venustus.* Nine cases of this trouble, in each of which a tick (in one case two ticks) was found attached in the hair below the occipital prominence, have been reported to us by Dr. I. U. Temple of Pendleton, Oregon. All of these cases occurred in or near the Wallowa Valley in northern Oregon. A similar case has been reported from Wyoming, and Professor Cooley has heard of one or two cases in Montana. The affliction as reported, first manifests itself as a partial paralysis of the lower limbs, the paralysis advancing to the upper part of the body and arms, ultimately affecting speech, deglutition and respiration. The symptoms subsided rapidly after removal of the tick. The point of attack seems to be an important factor in producing these symptoms. These observations by no means show conclusively that the condition has anything to do with the presence of the tick.[1]

Local, itching sores frequently follow at the point of attachment, especially if infection is introduced by scratching. Swelling of a limb and lameness have been known to persist for weeks following the bite of a spotted-fever tick which was left attached for some time.

Nymphs Attaching to Man

In two instances, one in the Bitter Root Valley and the other in Colorado, a single nymph of this species has been found attached to man. Although this must occur very rarely its importance should not be overlooked, owing to the fact that the nymphs of this species have been shown to be capable of transmitting Rocky Mountain Spotted-fever.

[1] Since this paper was submitted for publication an article by Dr. J. L. Todd (Canad. Med. Journ., Vol. 2, p. 1118-1119) records from British Columbia a number of cases analagous to that described.

It may also be mentioned that a very few specimens of nymphs have been taken on cattle in the Northwestern States.

Practical Application

The recommendations made in Bulletin 105 of the Bureau of Entomology for the control of this tick in the Bitter Root Valley have been strengthened by subsequent investigations. None of the recent findings indicate that any modification of the plan of eradication, as recommended in that publication, is necessary.

It might be mentioned, however, that by taking into consideration the maximum developmental periods and longevity of stages it would not be cause for surprise if living adults, developed from overwintered larvæ or unengorged nymphs, be found in pastures on the fourth spring after beginning dipping or destruction of ticks by other methods on domestic animals. It would be necessary, of course, that small wild animal hosts of the immature stages be present during this time. That this four-year maximum period will ever be attained is a very remote possibility since it has been found that the longevity and vitality of nymphs and adults are lessened if the previous stages (larva and nymph, respectively) are not fed until nearly dead from starvation. Moreover, it is hardly possible for one group of ticks successively to attain the limit of longevity in each stage before finding hosts.

THE POSSIBLE AND PROBABLE ETIOLOGY AND TRANSMISSION OF VERRUGA FEVER

By Charles H. T. Townsend, *Entomologist to the Peruvian Government, Lima, Peru*

Es tierra muy caliente y enferma especialmente de unas verrugas muy enconadas que nacen en el rostro y otros miembros, que tienen muy hondas las raices de peor calidad que las bubas.

—Agustin de Zárate, A.D. 1545.

In certain more or less restricted valleys on the Pacific slope of the central Peruvian Andes there exists today a disease known as verruga. From the earliest times the origin of this disease has been regarded as a mystery. At the time of the arrival of the Spanish conquerors verruga appears to have been much more widespread than at present, extending north into Ecuador. The quotation from Zárate refers to the Ecuadorian coast region. Today verruga is confined, so far as known, to Lima, Ancachs and Libertad departments, between 8° and 13° south latitude.

Dr. David Matto, Editor-in-Chief of the Crónica Médica of Lima, states that verruga has undeniably existed in the quebradas of the Rimac from the most remote times. He argues that the disease was known to the ancient inhabitants of Peru, since the native word "*kceepo*" applied to the verruga warts is distinct in root and meaning

from the Quechua word "*ticti*" applied to ordinary warts. A study of the historical works dealing with Peru at the time of the Spanish conquest indicates that verruga at that time extended from south-central Peru to northern Ecuador in the Andean valleys fronting the Pacific Ocean. The epidemic of disease that decimated the armies of Huayna Capac four centuries ago in this region was probably verruga, so far as can be judged at this date from the descriptions given at the time. This was before the advent of the Spaniards, so that smallpox is excluded. Thus it seems very probable that verruga, like plague, may remain dormant or confined to restricted endemic foci for centuries, and then suddenly, due to unusual sets of conditions, extends itself in epidemic waves causing a widespread desolation of the human race.

The following synonymy of the disease, given by Dr. Ernesto Odriozola, Senior Member of the Lima Faculty of Medicine, in his monograph of verruga published in Paris in 1898, is instructive:

(Fever phase)	(Eruptive phase)
Oroya fever	Blood warts
Carrion's malady or Carrion's grave fever	Soft warts
Verruga or verruga fever	Verruga andicola
Malignant fever of the quebradas	Verruga peruana
Pernicious anemia of the quebradas	Pervuvian warts
Pernicious intermittent malarial fever	Castille verruga
Malarial typhus of Oroya	Mule warts or toad warts
Anemic fever of the quebradas	Quinua warts
Acute wart fever	Bouton des Andes

The following distribution of verruga is taken from Dr. Odriozola's monograph:

Lima Department—Provinces of Yauyos, Huarochirí, Canta and Chancay contain six separate river systems infected, showing seven isolated valleys, with nineteen infected communities, and seven additional known infected but uninhabited localities, the whole ranging from about 2,900 feet to 7,900 feet altitude. The seven uninhabited infected localities known are in the V-shaped verruga district above Lima formed by the Rio Rimac (Rio Cocacharca) and its principal branch the Rio Santa Eulalia; they go by the names of Cupichi, Purhuay, Corcona, Urabamba, Esperanza, Agua de Verrugas (Verrugas Canyon and Verrugas Bridge), and Cuesta Blanca.

Ancachs Department—Provinces of Cajatambo, Huaráz, Huaylas and Pallasca, the last extending into the southern edge of Libertad Department, contain four separate river systems infected, showing eight isolated valleys, with sixteen infected communities, the whole ranging from about 1,300 to 10,900 feet altitude.

Throughout his detailed description of the geographical distribution

of the disease, Dr. Odriozola dwells on the fact that verruga localities are invariably situated either in or adjacent to deep narrow canyons with exuberant vegetation and great summer heat combined with little ventilation. Infected communities not actually situated within such canyons are so close to them that their inhabitants have to pass through them to a greater or less extent.

In July, 1912, Dr. Odriozola summed up briefly, in an address on verruga, certain results that have come to light since the publication of his monograph, from which the following points may be given: A few new verruga localities have been found since, and it is most probable that others still unknown exist, being off the roads of ordinary travel. All the known districts are in or next to deep ravines, where malaria is co-existent with verruga. All ages and races of men are susceptible, and it is also reported that verruga attacks domestic animals. One of the forms of the eruption derives its name mular from the fact that mules often exhibit a similar eruption supposed to be the same. The disease graduates all the way from acute to chronic. It thus presents many forms showing various degrees of virulence. The acute form is the Oroya fever or Carrion's grave fever, which is the most serious form of the disease. Three fundamental clinical characters distinguish it—fever, anemia, prostration. The anemia is always rapid and profound, and its intensity at times is almost incredible, in some cases the erythrocytes being reduced to 800,000 and even as low as 500,000 per cubic millimeter. At the same time the white corpuscles increase inversely. Patient becomes absolutely indifferent and immovable, in extreme cases even a slight movement of the head on the pillow being sufficient to produce vertigo. Diarrhœa is frequent but not always present; usually present in intense cases, at time becoming dysenteric and of inexorable tenacity. The high fever may last from fifteen to thirty days if death does not ensue; after that it begins to lower and the eruptive phase begins. The eruption is of the miliar type, appearing as minute elevations of the skin, pallid or roseate but sometimes intensely red. If the eruption is abundant and generalized, showing vigorously, then the patient is certain to recover.

The chronic form comprises the great mass of the cases, in which there is fever but not of the acute type above described. The fever here may be intermittent or remittent, pains in the joints are dominant especially in the hands and feet, the joints may swell and inflame, and anemia is present. The eruption is the culminating phase in both forms and takes various types, the miliar already described, the nodular of small to large knots or nodules, the mular as an enlarged type of nodular origin, and the pseudomular as an enlarged type of miliar origin.

Between these are various intergrades. The miliar class or type pertains usually to the acute form of the disease, while the nodular class or type is more distinctive of the chronic form; but numerous cases graduate from acute to chronic so that it is difficult to classify them. After a variable but always long duration, often of months, the eruption begins to decrease, loses its color, hardens, becomes encrusted, and finally sloughs without leaving any scar in the case of the true miliar and nodular types; but the enlarged types, mular and pseudomular, leave a whitish or pigmented mark on sloughing. The mular may attain such dimensions as to break of its own weight, admit germs, suppurate or ulcerate.

The only bodies yet found in the blood that can possibly be connected with verruga are Barton's x-bodies, discovered by Dr. A. L. Barton, of Lima. Dr. S. T. Darling, Chief of the Ancon Hospital Laboratory of the Canal Zone, has given a good account of them in the *Journal of the American Medical Association* for December 23, 1911, from which the following points may be taken: They are endoglobular and seen first as slender rod-like forms with rounded free ends, but cannot be detected in the fresh blood; thus their refractive index must coincide with that of the erythrocyte. The rods are occasionally single, oftener two or more up to six or eight and frequently grouped in parallel series. Some show filaments or irregularly disposed branches or pseudobranches. They stain dark blue or purple and never faintly blue with chromatin differentiation. After a few days they lose the slender form, swell irregularly, distort and become fragmented. If the disease progresses favorably the x-bodies disappear and the eruption comes out. Should the x-bodies reappear in their slender form and continue in large number in the peripheral blood, the patient dies. In all cases, according to Barton, the recovery of the patient coincides with disappearance of these x-bodies from the peripheral blood.

The following points were furnished me by Mr. A. J. Norris, Chief Consulting Engineer to the Peruvian Corporation: In 1909 a bridge gang of thirty North Americans was taken to Purhuay for work on the Central railway. Their camps and beds were all new and clean. They had no occasion to dig up the soil, being engaged in bridge work, and had practically no occasion to get into the herbage or other vegetation along the river bed. Within hardly more than a week twenty-nine of the thirty contracted verruga fever. The camp was then changed to Chosica, which is just below the edge of the verruga district, and new men were put on the Purhuay work but camped at Chosica, returning there every evening for the night. No cases appeared among these new men.

In 1906, at San Bartólome, which is in the verruga district on the

Central railway, 2,000 men were employed in tunnel work during the year. Among these there occurred 200 known deaths from verruga, and it is practically certain that still further deaths occurred among the many laborers who left the works and whose history was not followed up. The general experience with laborers on the Central railway has been that five or six nights passed successively within the verruga district causes the fever to appear in 75 per cent to 80 per cent of the workmen in a camp. In a week or so nearly all are certain to contract the disease. No animals of any kind were employed by the laborers in any of this work. Mosquitoes and buffalo gnats in abundance, as well as bedbugs and fleas, occur at Chosica and throughout the greater part of the verruga districts.

During the early stages of the work in the building of the Central or Oroya railway up to 1876, when the road was completed into Chicla, thousands and tens of thousands of laborers were employed, largely strong healthy Chileans, as many as 8,000 being carried on the pay-rolls at one time. During this period the recorded mortality from all causes—disease and accident—was some 7,000. A large majority of these deaths was doubtless due to verruga, the result of carrying the road through the verruga district of the Rimac which has given its name to Verrugas Bridge.

After this hurried historical survey of verruga we may proceed to make certain deductions from the data at hand, which may throw some light on the etiology and transmission of the disease. It seems practically proved that Oroya or quebrada fever and verruga eruption are the same disease. The history of the case of the American engineer Wilson who contracted the fever in the seventies of the past century and developed the eruption after returning to North America, indicated the identity of the two, and this was verified by Carrion's experiment upon himself in the eighties. Carrion produced the fever in himself by inoculation, after the manner of a vaccination, with blood from a verruga tumor. This experiment, which unfortunately terminated fatally, not only clinched the etiological identity of the fever and eruption phases, but also demonstrated that the disease is transmissable by inoculation.

The apparently established inoculability of the disease is the basis on which rests the arthropod-transmission theory. Dr. Julián Arce, of the National Academy of Medicine at Lima, was the first to suggest that verruga may be contracted through the agency of some animal bloodsucker. Later Dr. Darling, in the paper above mentioned, suggested "a tick or mosquito, or other suctorial invertebrate having a peculiar altitudinal distribution" as the carrier of verruga. It is well known that the disease can not be transmitted by mere contact as long

as the skin remains whole, nor can it be contracted through either the respiratory or alimentary tracts under normal conditions. It is a blood disease characterized by a breaking down of the erythrocytes, and like all other diseases of this class can be transmitted only by direct inoculation of blood or other vehicle containing its causative organisms in the infective stage. The only way for such inoculation to take place naturally is through the bites of bloodsucking arthropods. It is further proved that it can not be transmitted to man or other mammals by inoculation of blood taken from a verruga subject while in the fever phase of the disease.

The almost exhaustive hæmatological studies of verruga made during the past thirty years in Peru and elsewhere have as yet failed to reveal the causative organism of the disease. Barton's *x*-bodies, first described by Barton in 1905, are unquestionably directly related to the fever phase of the disease. They are uniformly absent during the eruptive phase, and uniformly present in the peripheral blood during the fever phase. They seem most likely to be a form of basophilia caused by a non-infective stage of the pathogenic organism of verruga, which organism is perhaps ultramicroscopic in all its stages and has thereby successfully eluded observation to date. This causative organism evidently reaches the infective stage only at the end of the fever phase or inception of the eruptive phase, and probably remains infective during the persistence of the latter.

The initial stage of Barton's *x*-bodies known by its slender rod-like form, would indicate the beginning of the attack of the pathogenic organism on the erythrocyte. The pyknotic and polymorphous stages would show the successive changes that take place in the erythrocyte during the progress of the attack, which finally results in the destruction of the erythrocytes affected. Cultures made from erythrocytes containing these *x*-bodies fail to produce verruga on inoculation. The natural deduction is that these bodies are the visible results of a non-infective stage of the organism, which metamorphoses to the infective stage in the subcutaneous tissues thereby giving rise to the eruption.

The transmission of verruga by bloodsucking arthropods being almost certainly indicated, the next important point is to know whether or not man is the primary reservoir of infection. This can be quite definitely answered in the negative. The fact that verruga can be contracted in localities uninhabited by man shows that the native fauna constitutes the primary reservoir. This is also unmistakably indicated by the restricted range of the disease. All bloodsucker-transmitted diseases whose primary reservoir lies in the native fauna are originally restricted to the range of that fauna or the portion of it infected. If their transmitters are able to spread outside the original

range and maintain themselves on man alone, then man constitutes a secondary reservoir to be feared, for the disease is bound to spread wherever the transmitter is able to carry it and maintain itself. This is the case with plague, which is transmitted from man to man by fleas that can maintain themselves on man. If, as is probable, the native fauna of any country ever constituted the primary reservoir of yellow fever and malaria, the fact is of little practical importance today, since infected man is now the prevalent and effective reservoir, whether primary or secondary, of these diseases, which are able to spread and become epidemic wherever their mosquito-transmitters can maintain themselves and infected subjects are present.

The fact that verruga is not spread throughout the coast region of Peru by the eruptive phase cases of the disease that are continually arriving therein from the verruga districts indicates beyond doubt that neither the fleas nor the mosquitoes of the coast region are able to transmit it. There are no mosquitoes nor fleas in the verruga districts that can not maintain themselves equally as well in certain similar districts known to be uninfected. There seems to be no reason why the native reservoir fauna of the verruga districts should not maintain itself in certain similar districts at present not infected. There is a possibility that both the reservoir fauna and the transmitter exist outside the actual verruga districts, but that the reservoir fauna is infected at present only in those particular districts. In this case, however, the transmitter must be such that its infected individuals can not spread, either on man or independently of him, from one similar district to another, for otherwise it would infect either man or the reservoir fauna, or both, in the uninfected districts invaded by it.

Fleas and mosquitoes can and undoubtedly do spread between these very similar deep-quebrada districts of the western Andean slopes and foothills, and they are therefore excluded as possible transmitters of verruga, for the disease does not spread with them. Buffalo gnats, horse flies, stable flies, and all other bloodsucking Diptera are likewise apparently to be excluded for the same reason. There are no dipterous forms present in the region that can in any way be likened to the tsetse flies with their local and zonal distribution dependent on presence of suitable conditions for their development. The conditions that exist in actually infected verruga districts are practically duplicated in many uninfected districts easily accessible to all bloodsucking dipterous forms present in the former.

Bedbugs, lice and all other bloodsucking hexapods are likewise excluded for the same reason as given above, while most of them are further excluded because they do not attack the native fauna. Moreover, all strictly day-biting bloodsuckers of man are excluded, because

it appears certain that the disease is usually contracted in the nighttime. Ticks may bite both day and night. They are not excluded because the infective individuals or adult females are large enough and evident enough to be seen and felt and thus avoided during the daytime or while man is awake, but can bite him for hours at a time while he is asleep. It is to be noted further that verruga may be contracted during various seasons of the year, but its principal season of prevalence is during March and April, about the close of the warm rainy season. This is the time of the year when the adult ticks are washed down the steep slopes by the rains and are thus to be found in the greatest number looking for hosts on which to engorge.

The fact that the verruga districts both descend lower and ascend higher in Ancachs Department than in Lima Department would indicate that neither the transmitter nor the reservoir of verruga is specially restricted or conformable to any particular range of altitude, but rather to the existence of certain conditions, and that both are equally at home in quite low as well as rather high altitudes. Certain ticks have an extensive altitudinal range, as the Rocky Mountain spotted-fever tick, while it is practically certain that no bloodsucking hexapods of the Andean region have such an extended vertical distribution as is covered by the verruga districts. The local differences in vertical range of the disease above pointed out would indicate dependence of the reservoir fauna or of the transmitter on local conditions not connected with altitude, as just hinted, perhaps primarily on the existence of uncultivated areas within each of the separated foci of infection. The eggs of ticks are very susceptible to the direct rays of the hot sun, and this may well account for the absence of verruga in certain districts under cultivation but within the altitudinal range of the disease. No such explanation can be applied in the case of hexapod bloodsuckers occurring in the region in question.

In March and April, 1912, verruga appeared at Matucana with considerable force, this locality being outside and above the infected Rimac district as theretofore known and at an altitude of about 7,800 feet. In certain years there are greater or less extensions of the disease. which seems usually to contract again the following year to its previous bounds. These fluctuations in range are probably only partially if at all dependent on periodic extension and contraction of the native reservoir fauna, carrying with it the transmitter as it advances or recedes and are more likely to be dependent on fluctuating extensions of the transmitter due to some unusual cause. As the Matucana extension took place near the end of the rainy season, it is likely that unusually heavy rains had washed the tick transmitters down the steep slopes of side canyons in the vicinity.

The breaking up of the erythrocytes in verruga is accomplished by an endoglobular activity of the causative organism. The only endoglobular hæmatozoans known to be transmitted by arthropods are *Plasmodium*, *Piroplasma* (*Babesia*), and *Leishmannia*. The pathogenic organism of verruga, if not ultramicroscopic, should be either one of these or a closely allied form. *Spirochæta*, *Trypanosoma* and *Filaria* are exoglobular, and thus excluded. *Plasmodium* is untenable, since it demands a culicid transmitter which is precluded by the conditions. It is impossible for a mosquito to have such a peculiar range as that indicated by the limiting boundaries of the verruga districts. The limits of these districts do not conform to limiting lines of any known mosquito environment, and the same may be said with regard to the environment of practically all other hexapod bloodsuckers of the region. *Leishmannia* is excluded as quite certainly transmitted by hexapods only. *Piroplasma* only remains, and it is especially concerned in tick-borne diseases. All the species of *Piroplasma* known are transmitted by ixodid ticks, and by these only. Thus, unless the pathogenic organiism of verruga be ultramicroscopic throughout all its stages, which it can hardly be, it is probably a form allied to Piroplasma.

In this connection it is significant that the various species of Piroplasma known to be transmitted by ticks and to produce piroplasmosis in its various forms have never been unmistakably identified in the bodies of the ticks, though indeterminate bodies have been seen by Koch and other investigators. Is it not possible that Piroplasma or some of its near allies pass an ultramicroscopic stage as sporozoites in the tick? Ricketts found that the pathogenic organism of Rocky Mountain spotted-fever exists in the gut, salivary glands and ovaries of the tick which transmits the disease, and further that it appears to proliferate in the tick. The amount of blood that one of the ticks could hold was found to produce only a mild case of the disease on being artificially injected, while the tick could produce several severe cases from one filling of blood. Inoculations from the salivary glands of the infected ticks produced the disease. Yet the organism itself is not thus far known. Ricketts found that fresh defibrinated blood, washed erythrocytes, and unfiltered serum produced the disease on injection, but filtered serum gave no result. Thus the pathogenic organism of Rocky Mountain spotted-fever appears to be non-filterable, but it is nevertheless apparently ultramicroscopic in its infective stage. Spencer claimed to have found ovoid intracorpuscular bodies showing amœboid movement, but his results are doubtful. Ricketts found what seemed to be an organism in the blood of infected guinea pigs and monkeys, to a less extent in the blood of infected man, and also in the bodies and eggs of infected ticks. This supposed organism is very likely a parallel to Barton's x-bodies of verruga.

The close parallelism existing between verruga and Rocky Mountain spotted-fever is especially significant. It is possible that both diseases are either ordinary or bizarre forms of piroplasmosis. Both are almost certainly caused by endoglobular hæmatozoans; both consist of a breaking up of the erythrocytes during the fever phase, with resultant anemia; both begin with a very variable fever phase and later develop profound dermatic disorganization; both are confined to certain restricted valleys in the mountainous regions of America; both exist through a wide range of altitude; both exhibit many graduated forms and degrees of virulence; both cause swelling and congestion of the spleen and liver; both may be contracted in localities uninhabited by man; both have their primary reservoir of infection in the native fauna; the specific pathogenic agent of neither is yet known, but indications in both point to a sporozoan allied to Piroplasma; both are almost certainly transmitted only by ticks.

It seems strongly indicated that verruga is transmitted by ticks in practically the same manner as is Rocky Mountain spotted-fever—that is to say, that the early stages of the tick live upon the small native mammals, while the adults attach to large animals and man for engorgement during which process they transmit the disease. This explains the mular eruption in mules in the verruga districts. The native reservoir fauna should be largely immune to the disease but carries in its blood from one generation to the next the pathogenic organism of verruga in its infective sporozoite stage. Immunity seems to be transmitted through only one generation, the third generation becoming again susceptible. The sporozoite is unable to develop at all in the native immunes, their erythrocytes being proof against its attack. It is able to develop and reproduce asexually in the erythrocytes of susceptible animals, and later to reproduce sexually in their subcutaneous tissues where it inaugurates the requisite environment. When the ultramicroscopic infective sporozoite stage of the pathogenic organism escapes in the ingested blood from the immune animals to the gut of the tick, it evidently leaves the gut and lodges in both the salivary glands and the ovaries, where it awaits unchanged an opportunity to gain access to the blood of a susceptible animal. From the salivary glands it escapes during the bite of the tick. From the ovaries it is transmitted in the ova to the succeeding generation of young ticks, in which it takes up its position in the salivary glands. It is reasonable to suppose that it always seeks the salivary glands in immature ticks and adults not yet fully engorged, but seeks the ovaries in fully engorged females which have no further occasion to feed. It evidently remains unchanged in the salivary glands through the transformation of the tick to adult stage, awaiting the engorgement of the adult to gain access to susceptible blood. Mules are evidently more or less

susceptible to the disease, hence the appearance of the eruption in these animals.

This hypothesis explains why verruga is not produced by inoculation of blood taken from patients in the fever phase of the disease; why it is produced by inoculation of blood and serum taken from the eruption; why mules show the eruption; why the native fauna is able to carry the disease without showing any evidences of it; why the fever and eruption take place in man and susceptible animals; why the pathogenic organisms of verruga and Rocky Mountain spotted-fever have not been seen in the blood; why ticks are necessary for the natural transmission of both diseases; why the pathogenic organism exists in the gut, salivary glands and ovaries of the tick, but is never seen in them; why some eggs deposited by a tick may be infected while others in the same lot are uninfected; why the pathogenic organism appears to proliferate or gain strength or number in the tick; why the bite of the adult tick from one filling of blood may produce several severe cases of the disease, while the same quantity of blood that the tick can hold artificially injected produces only a mild case; why the different degrees of virulence occur in both diseases; why the adult ticks are infective, and why the nymphs may have the infective stage of the organism in their salivary glands; why the ultramicroscopic primary stage of the organism is the only infective stage; why the organism does not transform in the tick; why it reproduces in the eruption of susceptible animals; why it enters the ovaries and eggs of the tick when the latter has become fully engorged; why one attack of either disease renders the subject immune; why both diseases are transmissable through the placenta to the second generation; why Rocky Mountain spotted-fever is not inoculable from guinea pig to guinea pig in successive generations, and why it is so by alternation between monkey and guinea pig. The same reasoning seems to apply equally throughout to the pathogenic organisms of verruga and Rocky Mountain spotted-fever.

As a working hypothesis we may thus infer that the ultramicroscopic infective primary or sporozoite stage of the pathogenic organism of verruga occurs in the ticks, in the verruga eruptions of susceptible animals, and in the blood of immunes. It probably undergoes development only in the blood of susceptible animals, and not in the ticks, and with equal probability it reproduces only in the eruption of susceptible animals. During its development through the trophozoite to the merozoite stage in susceptible blood, it is non-infective. After conjugation of the sexual elements in the dermatic tissues, the infective sporozoite progeny appears which needs new susceptible blood for its development. When a patient recovers from verruga and the eruption has finally sloughed, he has become immune to the disease.

It is further almost certain that, like the immune native reservoir fauna, he carries the infective sporozoite stage of the organism in his blood. This would explain what becomes of the pathogenic organism, so far as its continuous life-cycle is concerned, after it has reproduced sexually in the subcutaneous tissues of the susceptible animal. Having reproduced by conjugation in the eruption, the greatly multiplied number of resulting sporozoites invades the blood of the subject, which being now immune does not afford them the environment requisite to their development. The sporozoites must remain quiescent in the same infective stage awaiting the opportunity to transfer to susceptible blood. Thus immune man and mules may constitute a secondary reservoir of verruga—or immune dogs or other animals—but in any event the particular tick which acts as transmitter of the disease is necessary as the medium through which the sporozoites may, during the bite of the tick or during the bites of its progeny, gain access to the blood of susceptible subjects.

The difference in degree of virulence of both verruga and Rocky Mountain spotted-fever exhibited by different cases is probably directly due to the relative numbers of the infective sporozoite-stage organisms which gain access to the patient during the bite of the tick. The tick acts as a collector and reservoir of these sporozoites or infective organisms which become stored in its salivary glands. The number of these that gain access to the blood of a susceptible subject during the bite of the tick is directly dependent on the length of time that the tick remains attached. It was found that the minimum duration of attachment of an infective tick required to produce Rocky Mountain spotted-fever in a guinea pig was one and three-quarters hours. The average was found to be about ten hours, while twenty hours of attachment were almost invariably effective. Thus a short duration of the bite will produce a milder case in both diseases than double that duration by the same infective tick. The patient may be bitten by several infective ticks at different intervals, in which case each successive biting is certain to increase the number of the infective organisms in his blood. It is thus seen that variation in the number of infective ticks and in the duration of their attachment may produce all the known classes of verruga cases with their numerous intergrades.

In the uninhabited verruga districts there are few or no large animals for the adult ticks to engorge upon. Probably these ticks drop from the small native mammals as nymphs and change to adults on the ground, after which they crawl everywhere looking for large hosts. The small uninhabited tributary canyons which exist everywhere throughout the region, like the Agua de Verrugas canyon crossed by the famed Verrugas Bridge of the Central railway, almost certainly keep the disease alive and feed it constantly into the main canyons

and valleys. This may be done more or less by man and animals on the trails passing the embouchures of these tributary quebradas and canyons, the ticks becoming attached to their bodies or clothing. Almost certainly great numbers of the infective adult ticks are washed down the very steep inclines of these tributary quebradas during the rainy season, and spread themselves over the surrounding areas in their search for large animals on which to engorge. It is well known that the newly transformed adult ticks will live for as long as a year without food if they do not find a host in the meantime. Thus man and animals passing the mouths of these tributary canyons are apt to gather these ticks unawares, and man is especially apt to be bitten by them for hours at a time if he sleeps many consecutive nights in such localities. The long life of the infective adult ticks, provided they do not find a host, explains why verruga may be contracted at various times of the year quite irrespective of seasons but in more or less isolated cases. The March and April season of high prevalence of verruga is probably due to the large numbers of ticks washed down during the rainy season in the hills. An unusually rainy season, or a season in which there is greater precipitation during a given time, causing swifter freshets which reach farther than usual, may be responsible for the occasional extensions of the disease which have been noted, as for instance, the Matucana occurrence of 1912. There are doubtless many areas still unknown where the reservoir fauna breeds and the tick transmitters are to be found on the ground in large numbers.

Judging from the probabilities, it is therefore advisable to use much caution in order to avoid the attachment to the person of ticks of whatever kind throughout the western face of the central Andean region below 11,000 feet. Any ticks of the genus *Dermacentor* to be found on the ground or on large animals in this region may be infected with verruga. Those already attached to large animals will hardly leave them of their own accord for man, but those on the ground that are still searching for hosts are particularly to be feared. The danger is always greatest at night, while man is asleep, for their attachment does not wake him and is therefore not felt. Two species of ticks, *Margaropus australis* from the bodies of cattle, and *Ornithodoros megnini* from the ears of horses, cattle and sheep, have been taken by me in the Chosica region, but neither one has any relation to verruga. Both pass all stages including engorgement on the same host. It is the ticks which drop from the small hosts in the nymph stage and seek new hosts in the adult stage that are to be guarded against as possible verruga carriers. These may belong to any one of the genera *Dermacentor*, *Rhipicephalus*, *Hæmaphysalis*, and *Amblyomma*, one or more species of all of which are known to drop to the ground for both moults.

As to the possible identity of the native fauna which constitutes

the primary reservoir of verruga, certain of the native rats and mice or other small rodents are most strongly indicated. The rice rats, comprising many species of *Oryzomys*, are common throughout South America and well represented in the whole coast region of Peru; they are probably not concerned in verruga transmission at present, though there is a possibility that they might become so under extraordinary conditions. The *Octodontidæ* and especially the *Cricetinæ*, relatives of the pocket mice and grasshopper mice, are very abundant in forms in the Andean region, and it seems most probable that among them is to be found the primary reservoir of verruga.

Note.—Since writing the above, two important points with reference to verruga have come to light. The Magdalena quebrada, in the department of Cajamarca, has very recently been found to be a strong focus of verruga. Various other localities that have been discovered since the publication of Dr. Odriozola's monograph show verruga to be present at this date in the departments of Lima, Ancachs, Libertad, Lambayeque, Cajamarca, probably the southeastern corner of Piura, and perhaps the southwestern part of Amazonas, extending the known present range northward to 6° south latitude.

The other point is that Drs. Júlio C. Gastiaburú and Raul Rebagliati, of the Lima Institute of Hygiene, have recently found in the eruption of verruga and in the liver of verruga patients in the eruptive phase certain bodies, at times endoglobular, in leucocytes and certain cells, at other times free, which by their staining reaction and morphological aspect seem to them to resemble organisms of the genus *Leishmannia*. It is possible that these are the ookinete stage of the pathogenic organism before it has given off the numerous ultramicroscopic infective sporozoite-stage organisms.

The same authors have found also certain new endoglobular bodies in successive degrees of segmentation which they consider to be remnants of nuclear disorganization of the erythrocyte, and which suggest to them that Barton's *x*-bodies may be chromatin filaments segregated from the nuclei of the erythroblasts. It is probable that these endoglobular *x*-bodies of the erythrocytes, including Barton's *x*-bodies, are the results of the disorganization of the erythrocyte by the invisible non-infective trophozoite stage of the pathogenic organism, during its development to the merozoite stage. The merozoites evidently do not attack new erythrocytes, but as soon as produced they congregate in the subcutaneous tissues. Here some of them develop to male and female gametocytes, from the conjugation of whose elements the ookinete is formed. The plan of life-cycle and reproductive habit here suggested for the pathogenic organisms of both verruga and Rocky Mountain spotted-fever are, of course, purely hypothetical,

but they appear to furnish the only logical explanation of all the phenomena exhibited by both diseases.

PECULIAR EFFECTS OF THE STING OF A WASP

By Arthur H. Rosenfeld and T. C. Barber, *Tucumán, Argentina*

In the early morning of the 23d of October last, we were called to the bedside of a gentleman who stated that he had been bitten by some insect. We arrived at his room about twenty minutes after he had felt the puncture. He told us that he had awakened feeling something crawling on his face, and when he attempted to brush it off the creature had bitten or stung him twice just below the eye. He stated that he could distinctly feel the injected substance going through his veins, and his assertions were confirmed by the fact that, although it was then less than half an hour from the time of puncture, almost his entire body had turned red, and in many parts, particularly on the back and on the arms, there was a breaking out having the appearance of prickly heat. The gentleman was undergoing great pain as the irritation all over the body was very intense. The skin below the eye had already swollen, so that this organ was almost closed, and both arms, particularly around the wrists, had swollen considerably.

A careful examination of the bed revealed a large black spider, but this was thoroughly confined inside of a mosquito bar which had not been used that night. The only other insect which could be found in the room was a partly crushed wasp, apparently of the genus *Tachytes*, which was resting on a hanging part of the mosquito bar, close to the sufferer's head. It appeared that this must have undoubtedly been the insect which had done the damage. It is more than probable that, after the first sting, or during the progress of the second, the insect was struck, thus forcing an undue amount of formic acid amongst the delicate nerves below the eye. The intense irritation passed off in about an hour, although, naturally, the side of the face which had been stung was severely swollen for several days.

The results of this sting were so peculiar that we have thought it worth while to put them on record, and we should appreciate hearing from anyone else who has seen similar effects from the same cause.

N.B.—A few days after this was written a little native girl, about twelve years of age, was stung by a wasp from the same nest. This sting was on the lip. Within a short while both limbs had swelled so that she could not stand, but all effect had worn off by the next morning except immediately in the vicinity of the sting. A few days afterwards a young man was stung on the wrist, his arm swelling painfully to the shoulder. The irritation disappeared shortly as with the other cases.

SOME EXPERIMENTS WITH ROËNTGEN RAYS UPON THE CIGARETTE BEETLE, LASIODERMA SERRICORNE FABR.

By A. C. Morgan and G. A. Runner, *Bureau of Entomology, U. S. Department of Agriculture*

In the Journal of Economic Entomology, Vol. 5, No. 2, pp. 189–192, Mr. W. D. Hunter brought the subject of the effect of the Roëntgen rays upon insects up to date, and discussed a large number of experiments that were performed under his immediate direction. He concluded that there was no indication that X-rays had any effect upon insects.

In the fall of 1912, in pursuance with instructions from Mr. Hunter, the writers proceeded to Tampa, Fla., to test an X-ray machine built for "sterilizing" cigars upon a commercial scale. The promoters claimed that this treatment would either kill or render harmless, all stages of the cigarette beetle, that is, eggs would fail to hatch, larvæ and pupæ would cease to develop, and adults would lay sterile eggs. Since it was possible to give somewhat longer exposures with the Tampa machine than it was found possible to secure with the apparatus at Mr. Hunter's command, and since the cigarette beetle was not included among the species treated by Mr. Hunter, it is thought that a brief discussion of the Tampa experiments might be of interest to this Association.

Briefly, the machine and the method of treatment may be described as follows: The machine consisted of an alternating current transformer with a mechanical rectifier; the rectifier is so adjusted that only the peaks of the rectified waves are taken off the commutator and put through the X-ray tubes. Therefore, the rays produced were of high penetration but of comparatively low burning power, that is, there was a minimum of the Gamma, or burning ray. Two 7-inch X-ray tubes of the self-regulating type are mounted in the leaded exposure chamber. This chamber is six feet long, about two and a half feet broad and two feet high; each tube is placed near opposite corners of the box, about twenty inches from the ends and about eleven inches above the belt carrier. During a commercial run the carrier would move a box of cigars through the field of the rays in nine minutes. The capacity of the machine is about 40,000 cigars a day.

The tubes are customarily started "hard" (*i. e.*, with great resistance), so they will back up a spark gap of 4 to 4½ inches which is equivalent to a voltage of from 64,000 to 70,000. The commercial current passed through the tubes ranged from 1½ to 2½ milliamperes,

at which rate the tubes could be used about thirty minutes continuously. When the amperage is increased the tubes heat up quickly and must be changed. Changing and regulating the tubes consumes so much time that more frequent changes than every half-hour cannot be considered in commercial work.

During our experiments the machine was tested at the commercial adjustment, and afterward the most severe exposures were given of which the machine was capable. Tubes were run both "hard" and "soft," the time of exposure varied from a few seconds to one hour, the voltage from 30,000 to about 75,000 and the amperage from $1\frac{1}{2}$ milliamperes to 14 milliamperes, except in one experiment when the amperage reached 20 milliamperes for 30 seconds. In most instances instead of moving the material through the cabinet upon the carrier, it was placed the closest possible to one of the targets or at the common focus of the two targets.

The following is a brief resumé of the experiments in tabular form:

TABLE SHOWING DETAILS OF X-RAY EXPERIMENTS UPON *LASIODERMA SERRICORNE* FABR., AT TAMPA, FLA.

No. of experiment	Parallel spark gap	Current (milliamperes)	Distance from target in inches	Exposure		Stages exposed
				date	time	
1	....	$2\frac{1}{4}$	$10\frac{3}{4}$	Oct. 5	9 min.	adults, eggs, larvæ
2	....	*	$10\frac{3}{4}$	Oct. 5	**	adults, eggs, larvæ
3	$4\frac{1}{8}$	$1\frac{3}{4}$–$2\frac{1}{2}$	12–30	Oct. 7	11 min.	adults, eggs, larvæ
4	....	12–14	$10\frac{3}{4}$	Oct. 8	1 min.	eggs, larvæ, pupæ
5	$4\frac{3}{8}$	$1\frac{3}{8}$–$1\frac{1}{2}$	$10\frac{3}{4}$	Oct. 10	10 min.	eggs
6	$4\frac{3}{8}$	$1\frac{1}{2}$	$10\frac{3}{4}$	Oct. 10	30 min.	eggs
7	$3\frac{3}{4}$	3	$10\frac{3}{4}$	Oct. 10	10 min.	eggs
8	$4\frac{1}{4}$	3	$10\frac{3}{4}$	Oct. 10	30 min.	eggs
9	....	$3\frac{1}{2}$	$10\frac{3}{4}$	Oct. 10	50 sec.	eggs
10	$1\frac{7}{8}$	$2\frac{1}{2}$	$16\frac{1}{2}$	Oct. 15	10 min.	all stages
11	$2\frac{1}{2}$	2–$2\frac{1}{2}$	$16\frac{1}{2}$	Oct. 17	30 min.	all stages
12	$3\frac{1}{4}$	2–$2\frac{3}{4}$	$16\frac{1}{2}$	Oct. 23	20 min.	all stages
13	$3\frac{1}{4}$	$2\frac{1}{4}$ & $2\frac{3}{4}$	$16\frac{1}{2}$	Oct. 25	15 min.	all stages
14	$3\frac{1}{2}$	$2\frac{1}{2}$–3	$10\frac{1}{2}$	Oct. 26	$2\frac{1}{2}$ min.	all stages
16	$3\frac{3}{4}$–$4\frac{1}{2}$	2	$10\frac{1}{2}$	Nov. 6	30 min.	adults, larvæ, eggs
17	$3\frac{3}{4}$	2	$10\frac{1}{2}$	Nov. 9	1 hour	all stages

* The exposure in No. 2 was, 5 min. at 8 milliamperes, 1 min. at 9 milliamperes, 30 secs. at 20 milliamperes and 3 min. at from $1\frac{1}{2}$ to $2\frac{1}{2}$ milliamperes.

** The total time in No. 2 was $9\frac{1}{2}$ minutes.

General results of the above experiments:—the life history of the treated material in every experiment proceeded normally as in the check. Results were, therefore, negative.

A detailed discussion of two of the experiments will serve to indicate the results obtained in all. Experiment No. 3. The following material was used: eggs deposited the night of October 6, 20 larvæ and

10 adults, the exposure was made October 7. All material was placed in pill boxes, cigar box lids were placed over the boxes instead of the regular lids. The boxes were placed upon the belt carrier and were run through the rays in eleven minutes. Minimum distance from the target eleven inches, maximum distance about thirty inches. Parallel spark gap $4\frac{1}{8}$ inches which was equivalent to about 65,000 volts. Amperage $1\frac{3}{4}$ to $2\frac{1}{2}$, averaging slightly over two, milliamperes. Results of examinations: October 15 all exposed eggs and all check eggs had hatched. October 17 treated larvæ and check larvæ were pupating. Treated larvæ presented a normal appearance. October 17 only one treated adult alive; also only 1 check adult alive. The treated adults deposited eggs October 9 and 10. Both these lots of eggs had hatched by October 17.

Experiment No. 17. Exposure made November 9. In this experiment five boxes of badly infested plug cut smoking tobacco were exposed to X-rays for one hour. Parallel spark gap five inches at beginning of experiment; average $3\frac{3}{4}$ inches. Current two milliamperes. One 7-inch tube used. Material exposed was placed directly beneath the tube, distant from target $10\frac{1}{2}$ inches. The tin covers of the tobacco boxes were opened. All stages of the beetle were present. The tobacco was not disturbed, except to open the paper covering over which the lids of the boxes fitted. Directly after exposure, the covers of the boxes were closed and the boxes placed in a tight receptacle so that the beetles could not escape, or further infestation occur from beetles coming in from without. Five boxes of infested tobacco similar to those exposed were prepared in like manner and kept as a check. On November 11, the material was examined and adults, larvæ and pupæ were apparently normal. On November 12 the material was shipped to the laboratory at Clarksville, Tenn., and was placed in a greenhouse soon after arrival. Frequent examinations of this material in the past few weeks have shown that the treated material has been developing normally in every respect, corresponding to the development of the check material. In the treated material, larvæ have continued to pupate, pupæ have become adult, and the newly emerged adults that were isolated have deposited eggs. This material is being kept to observe any possible effect upon the second generation.

The experiments just discussed were performed upon the commercial machine which produced rays of high penetration but very few of the Gamma, or burning rays. In order to test the effects of the Gamma rays, Experiment No. 14, was performed upon a therapeutic machine consisting of a coil, a chemical interrupter, and an electrolytic rectifier. This form of rectifier, instead of changing

the direction of half the alternating waves, simply prevents the passage of the waves in one direction, allowing the passage of the entire wave in the direction desired, only half the energy put into the transformer being passed through the tube. As a matter of fact, in making this experiment, it was found that when a current of more than $2\frac{1}{2}$ milliamperes was passed through the rectifier and the X-ray tube, that the rectifier did not act positively and that current was passed through the tube in both directions, setting up a condition commonly called "inverse" by X-ray operators. The machine was adjusted, by the introduction of a spark gap in the circuit, to a point where this "inverse" just disappeared. It may be assumed, therefore, that the entire wave was passed through the tube. In other words, the impulses sent through the tube were complete waves from a point of very low pressure up to the maximum pressure produced by the apparatus, and down again to the point of lowest pressure which would pass through the tube. The tube used in this experiment was quite "soft" or of comparatively low resistance. The X-rays generated were, therefore, of comparatively low penetration, but of great burning power. The material treated was exposed directly to these highly reactive rays, and the effect produced might be expected to be the maximum possible for the "soft" rays from an X-ray tube. One 7-inch tube was used, material was uncovered and placed directly under the tube. Distance from the target $10\frac{1}{2}$ inches, spark gap $3\frac{1}{2}$ inches, milliamperes $2\frac{1}{2}$ to 3, averaging slightly over $2\frac{1}{2}$. Time of exposure $2\frac{1}{2}$ minutes. The time of exposure, owing to the construction of this type of machine, was about the maximum practicable; and to secure this exposure 15-second flashes had to be given with considerable intervals to allow the apparatus to cool. The material used in this experiment (No. 14) was as follows: adults exposed 18, check 23; eggs, exposed 10, check 10; larvæ, exposed 50, check 50; pupæ, exposed 10, check 10. The following gives briefly the results of the examinations: *adults* October 29, three dead, two escaped and thirteen left alive in box of exposed material, eggs had been deposited and these were isolated for further examination; of the check adults, ten were alive and thirteen dead, check adults had also deposited eggs which were isolated. November 8, ten of the exposed adults were still alive while only five were alive in the check. Eggs had been deposited in both boxes. At this examination, eggs taken from boxes of exposed and check adults October 29, were hatching.

Eggs—November 8, eggs were hatching in both the exposed and the check lots.

Larvæ—November 8, both lots of larvæ normal in appearance, two pupæ found in exposed lot and two in check lot. Shortly after

this date the material was moved to Clarksville, Tenn., where the temperature was very much lower than at Tampa. At the present writing, December 27, the remaining larvæ in the exposed and check lots are perfectly normal in appearance and are feeding.

On November 2, nine of the exposed pupæ had become adult, one was crushed during an examination. By November 8, five of the check pupæ had become adult, the other five had died. December 27, eggs deposited by adults developing from exposed pupæ have hatched.

It is evident from the above experiments that neither the "hard" nor the "soft" rays used gave any indications of affecting any of the stages of Lasioderma.

X-rays are known to have a very decided injurious effect upon certain tissues and functions of the higher animals, and it seems strange that this effect should not be noticeable upon insects. Since there are other rays, little understood and little studied—said to be associated with the hard and soft rays, the question naturally arises, would any of these, if properly isolated, produce any effect upon insects.

SOME NOTES ON LAPHYGMA FRUGIPERDA S. AND A. IN PORTO RICO [1]

By Thomas H. Jones, *Assistant Entomologist, Experiment Station, Porto Rico Sugar Producers' Association, Rio Piedras, P. R.*

The so-called "southern grass worm" or "fall army worm," the local Spanish equivalent of which is "el gusano de yerba," is a pest of considerable importance in Porto Rico. Because of this, and because any data concerning this insect will be of timely interest, on account of its unusual abundance in the eastern United States during the past season, the following article has been prepared. This account deals with its occurrence, life history, and enemies in Porto Rico, and includes a short note on an experiment with poisoned bait. There is also appended a brief statement regarding another Noctuid, *Remigia repanda* Fab., since, because the larvæ of this species are sometimes found accompanying those of *Laphygma frugiperda*, it has been necessary, in this article, to include more or less data concerning its occurrence.

This paper is a summary of the field and breeding notes on *La-*

[1] Published by permission of Mr. J. T. Crawley, Director of the Experiment Station of the Porto Rico Sugar Producers' Association.

phygma frugiperda, contained in the files of the Experiment Station of the Porto Rico Sugar Producers' Association at Rio Piedras, P. R. Determination of the two species of moths, *Laphygma frugiperda* and *Remigia repanda*, were made by Dr. H. G. Dyar of the Bureau of Entomology, United States Department of Agriculture.

Distribution in Porto Rico. Adults of *Laphygma frugiperda* have been reared from larvæ collected at Rio Piedras and Arecibo on the north coast and Ponce on the south coast, and from pupæ collected at Mameyes on the north coast. Mr. D. L. Van Dine, entomologist of this station, has observed larvæ on sugar cane in the following additional localities:—Buena Vista and Barceloneta on the north coast, Naguabo on the east coast, and Santa Isabel on the south coast. This list of localities gives a wide distribution around the island, near the coast. Since Dr. Agustin Stahl of Bayamon, Porto Rico, included this insect in his "Fauna de Puerto Rico," published in 1882, over a quarter a of century ago, it is probable that it is generally distributed over the island. The reason why it is recorded by the station, for the most part, from the areas lying near the coast is because cane growing, the industry with which the activities of the station are connected, is generally restricted to those areas.

Food Plants. Sugar cane, "malojillo" (*Panicum barbinode*, a grass occurring naturally in Porto Rico on the low, moist meadows, and grown extensively on such areas as food for stock), corn, and onions, are the plants from which larvæ of *Laphygma frugiperda* have been collected and the adults reared at the station at Rio Piedras. From the first three it has been taken several times, while the one record of the occurrence of the larvæ on onions refers to specimens taken within the leaves of that plant in a small vegetable garden.

From what is known concerning the food habits of the species elsewhere, future investigation will undoubtedly add many more names to this list of Porto Rican food plants.

Records of Injuries and Occurrences. Larvæ of *Laphygma frugiperda* are sometimes very abundant locally in Porto Rico during the wet and slightly cooler fall and winter months. The areas attacked may be on land which neighboring rivers have recently overflowed or they may be on land where such flooding has not occurred. So far as observed, serious injury to sugar cane at such times has been to young cane. An outbreak in which cane areas were involved was noted by Mr. Van Dine at Buena Vista on October 3, 1910, following floods, and injury to cane subsequent to similar conditions occurred at Rio Piedras during January, 1912. On November 23, 1912, larvæ and pupæ were collected from land planted to sugar cane at Mameyes, on a hillside where the "grass worms" had been unusually abundant.

The cane in this field was young plant cane, that is, cane at the beginning of its first year of growth.

The larvæ and pupæ collected at Mameyes on November 23, 1912, were taken from a field containing, it is estimated, twenty-six acres. The leaves of the cane plants over an area of some four acres had been eaten to the midribs by the larvæ of *Laphygma frugiperda* and *Remigia repanda*. The degree of injury to the cane over the remainder of the field, as well as in adjoining fields, varied. Unfortunately, at the time of the writer's visit to this locality, the greater proportion of the destructive brood of "grass worms" had completed their development and pupated. Comparative notes on the abundance of the two species could, therefore, not be made. The leaves of old ratoon cane in a nearby field, the plants being some six or seven feet in height, had also been attacked by "grass worms." The amount of defoliation here did not appear to be as great as on the young cane, though it must be borne in mind that the same amount of defoliation would be more evident on the young cane.

There was a considerable growth of "malojillo" in parts of the fields and in some sections this had been "stripped." It appeared, however, that the degree of injury to the cane in various parts of the attacked areas did not depend upon the presence or absence of grass in those parts.

On January 11, 1912, larvæ of *Laphygma frugiperda* and *Remigia repanda*, the greater proportion full grown, occurred in enormous numbers at Rio Piedras over an area that had been overflowed during the previous month. Part of the section on which they were present was in pasture; the grass growing on the land being largely "malojillo." Part of a field of "malojillo," the crop on which was about three feet high, and part of a field of young sugar cane was also being attacked. The larvæ had "stripped" the grass and cane so that only the grass stems and the stalks and midribs of the cane remained. When seen from a distance, the area was well defined, the difference in color between it and the uninjured vegetation bordering it being well marked.

Injury in the La Plata river valley, following floods that occurred at the same time as did those at Rio Piedras, was reported to Mr. Van Dine by Mr. P. H. Gorman of the Porto Rican-American Tobacco Company. The writer visited the valley on January 23, 1912, but found very few "grass worms," though the results of their feeding on the grass in the valley was just as pronounced as at Rio Piedras, part of the area where they had been so plentiful being some distance above the area previously overflowed. The writer was told that the "worms" had, at one point in the valley, damaged tobacco plants to

some extent. The few larvæ collected on January 23 were those of *Remigia repanda* and an unidentified species, though, from the description of the "worms" that had been so common, it seems probable that larvæ of *Laphygma frugiperda* had, with those of *Remigia repanda*, done practically all the damage.

The "southern grass worm" is sometimes found on young plant sugar cane, working on the opening whorl of leaves. This injury may, apparently, occur on cane planted at any season of the year.

Injury to young seedling canes has been observed at Rio Piedras, the larvæ possibly having originated in the grass used for shade on the boxes in which the seedlings were growing.

Corn growing in Porto Rico is severely attacked by a number of insects and *Laphygma frugiperda* is an important pest of this crop. The injury is largely confined to the inner leaves of the young corn plants, though when the plants are very young the larvæ, of necessity, sometimes work on the outer leaves.

Possible Factors Governing Abundance. Outbreaks of the "southern grass worm" in Porto Rico occur only at certain periods. These outbreaks appear to be governed by climatic conditions; occurring during the fall and winter seasons when there is an abundance of rainfall and when the temperature is somewhat lower than at other seasons. There is, during these seasons, a more abundant growth of grass, which may be favorable for the development of the larvæ because of the abundance of food.

Abundance of larvæ following floods may perhaps be due to the fact that when the rivers recede there is left on the areas, previously covered by the water, more or less additional vegetable débris and soil. This deposited material may contain eggs or larvæ which the surface water from the watersheds of the rivers has brought down and which would, therefore, be concentrated on the overflowed areas when the rivers subsided.

It may be that unsuitable conditions, such as abundance of water, lack of food, or lower temperature, in certain sections, cause the species to seek other areas. If there is a migration, it would be interesting to decide what factor or factors are accountable for the selection of any particular area in which to breed.

In all of Mr. Van Dine's field notes on this species it is stated that the injury to sugar cane was in fields of young plant cane. This appears to be the case both when the larvæ occur in great numbers and when they are present in small numbers, scattered through the fields. This may be due to the fact that, in the vegetation growing on the land, previous to the planting of the cane, were natural food plants of *Laphygma frugiperda*, the species attacking the cane after

the removal of this growth. Generally speaking, grass is more abundant in fields of young plant cane and this may have some connection with the attack on the cane. Larvæ may also invade cane fields from adjoining grass areas, especially when the food supply becomes exhausted.

The larvæ apparently prefer the young cane. Mr. Van Dine states that the severe injury following heavy rains at Buena Vista was confined to the young cane, there being no apparent injury to the more mature cane growing on land that had also been under water. At Mameyes the young cane had apparently been preferred to the older growth. This may be because the larvæ do not naturally seek the higher plants. In an extensive article on this insect, published in 1901, Dr. F. H. Chittenden states, "—these larvæ prefer low growing plants."[1]

There have been remarkably small second broods of larvæ in localities where outbreaks of "grass worms" occurred. At Rio Piedras, although moths from the larvæ of the destructive brood were seen to issue in some numbers, the second brood of larvæ was of small consequence. Neither were there any reports of abundant second broods at other points on the island where similar outbreaks had occurred. This decrease in numbers can be accounted for, in part, by the presence of parasites and predaceous enemies, and cannibalism may play an important part in the reduction of the species on areas where the supply of vegetable food becomes exhausted. One case of cannibalism was noted in the field at Rio Piedras, one Laphygma larva being seen to grasp another and soon disembowel it, both specimens being on the surface of the soil at the time and the attacked larva apparently about to molt. It is also possible that the moths, on issuing, may fly to a considerable distance before depositing their eggs, the result being that the larvæ of the second brood are scattered over a larger area and the results of their feeding not so apparent.

Life History. On April 27, 1912, the writer found a cluster of forty-six eggs of *Laphygma frugiperda* on the upper surface of a leaf of young plant cane at Rio Piedras. The eggs hatched on April 30 and eight of the newly hatched larvæ were placed in separate glass vials, plugged with cotton and containing leaves of "malojillo." The remainder were placed in a battery jar containing moist earth and "malojillo." The contents of the vials were examined from day to day, the grass and excreta being removed and fresh grass introduced. As the larvæ approached maturity they were transferred to glass bottles containing moist earth; leaves of "malojillo" still being given as food. The larvæ in the battery jar were not as closely watched, though they

[1]Bulletin 29, new series, U. S. Dept. of Agric., Div. of Ent., p. 31.

were kept supplied with fresh grass and the earth in the jar was kept moist. Until the third molt the larvæ fed only on one epidermis of the grass, but after that upon the entire blade.

With the exception of one larva, which for some reason did not develop as quickly as the others, all the larvæ entered the soil on May 21. Seven consecutive molts of the head were found in four of the vials and six in the remaining four, the time elapsing between molts ranging from two to four days, and the last molt occurring, on an average, five days before the larva entered the soil. Four of the seven moths obtained from the larvæ originally placed in the vials issued twelve days after the larvæ had entered the soil to pupate. Two remained in the soil eleven days and one thirteen days. On June 3, a day after the majority of these issued, two adults came from the soil in the battery jar. No other specimens were obtained from the jar.

Summarizing, we have, under the breeding-house conditions, and the climatic conditions prevailing at the time, twenty-one days for the larval period and an average of twelve days for the prepupal and pupal stages combined.

From observations made on this insect the writer believes that the time necessary for the completion of its life cycle in Porto Rico varies considerably, this variation depending upon the temperature and moisture conditions. This difference might, perhaps, not be expected, since the temperature conditions, especially on the north coast, are quite equable. Four adults, from larvæ that were collected when very small and cared for in the same way as were those on which the above life history notes were made, issued from the soil in April, sixteen days after the larvæ had gone below the surface. This is a period of four days longer duration than was necessary for the prepupal and pupal stages during the latter part of May of the same year. Other notes show a difference in the length of time consumed in the various stages of development, but unfortunately we have no thermographic or hygrographic records to accompany them.

The breeding records of the station show that adults, from eggs or larvæ collected in the field, have issued at various times during the months of January, February, March, April, July, October and December. Further observation throughout the year will probably show that the larvæ are to be found throughout the twelve months.

Enemies. Three species of Tachinid flies have been bred from *Laphygma frugiperda* at the station at Rio Piedras. These have been determined by Mr. W. R. Walton, of the U. S. Bureau of Entomology, as *Frontina archippivora* Will., *Gonia crassicornis* Fabr., and *Archytas piliventris* V. d. W.

Adults of a Carabid beetle, *Calosoma alternans* Fabr. (determined by

Mr. E. A. Schwarz of the U. S. Bureau of Entomology), as well as larvæ, probably of this species, have been taken in areas where the "southern grass worm" was abundant. A single adult of a smaller species of Carabid was reared from a larva taken at Rio Piedras near poisoned bait, where dead larvæ of Laphygma were present.

Lizards probably feed on the larvæ and adults and may be important enemies of the species.

Two species of blackbirds occur in Porto Rico, known locally as "el chango" or "mozambique" (*Holoquiscalus brachipterus*) and "el Judio" (*Crotophaga ani*). Both of these blackbirds undoubtedly do a great deal of good in reducing the numbers of caterpillars, particularly those occurring in the more open grasslands.

Results from the Use of Poisoned Bait. On January 13, 1912, an experiment was made with poisoned bran at Rio Piedras. One-fourth pound of Paris green and ten pounds of bran were mixed and enough water, sweetened with molasses, added to make the particles of the mixture adhere. The compound was placed in small piles on ground, very free from vegetation, between a field of grass, in which the "grass worms" were very plentiful, and a plot of young cane which they were apparently just beginning to attack. Larvæ, largely those of *Laphygma frugiperda*, found dead around the piles on January 16, were referred to Dr. F. W. Zervan, chemist of this station, for analysis, and he later reported that their bodies gave a decided arsenic reaction.

In connection with the outbreak of "grass worms" in the La Plata region, the writer was told that poisoned bait, the composition of which was not learned, distributed in a furrow through a field of grassland, had destroyed larvæ "by the hatful."

A Note on "The Grass Looper," *Remigia repanda* Fab.

Where outbreaks of the "southern grass worm" occur the larvæ are often accompanied by the larvæ of *Remigia repanda*. In the area attacked at Rio Piedras during January, 1912, the larvæ of *Laphygma frugiperda* appeared to predominate, though they did not greatly exceed "the grass looper" in numbers. While the two species occurred together, one or the other prevailed in sections of the whole area. At the other points where outbreaks occurred, no data was obtained on the relative abundance of the two species, the larvæ having, for the most part, pupated at the time visits were made to these areas.

As has been mentioned, the larvæ of *Laphygma frugiperda* prefer to work among the opening leaves of the cane, while those of *Remigia repanda* work upon the unfolded leaves, the older as well as the younger portions of the plants being eaten. When the food supply becomes scanty, however, this difference in feeding habits is less pronounced.

PEACH "STOP BACK" AND TARNISHED PLANT BUG

(*Lygus pratensis* Linn.)

By Leonard Haseman, *Department of Entomology, University of Missouri*

For many years the nurserymen of Missouri as well as those of other states have been confronted with injury to peach and pear buds in the early spring. This injury has been laid to various causes. Some attribute it to the work of thrips, others to mites and in some cases it has been supposed to be due to soil conditions. A number of papers during the past year have appeared in which the relation of the tarnished plant bug to this injury has been carefully discussed. In the writings of some of the earlier entomologists we find brief discussions of the importance of the tarnished plant bug with reference to the destruction of buds and to the injury it does to fruit and plants in general. It is not strange, therefore, that we should suspect this insect and attribute to it at least a part of the injury to peach and pear buds.

For the past two years the writer has been following the injury commonly spoken of as "stop back" of peach here in Missouri and finds that the tarnished plant bug is responsible for this injury. The injury is worse some seasons than others and seems to be worse in certain parts of fields. Invariably it is the more thrifty growing nursery stock which suffers most and this is usually in the damper parts of the nursery blocks and where the soil is richest. During the past spring this injury was probably as noticeable in certain sections of Missouri as it has even been known to be in this state. Some seasons the injury begins to appear soon after the dormant buds in budded peach stock begin to push out but fortunately the past summer it did not occur until the first week in June after the young growth had advanced from eighteen inches to two feet and therefore was not especially destructive, though in some portions of the infested blocks nearly all of the growing buds were killed. This injury occurs all of a sudden and the agent of destruction seemingly disappears from the nursery almost as suddenly.

The study of this pest is being carried on at the Experiment Station and in one of the nurseries of central Missouri. The nurseryman notified the writer on June 7, three or four days after the first severe signs of the pest appeared, and on arriving at the nursery it was found that but few bugs still remained in the nursery, but on visiting adjoining fields of clover, timothy and weeds it was found that they were present in great swarms, especially in clover where they were at work

depositing eggs. The writer learned that with the first appearance of the wilting of the buds these same swarms of tarnished plant bugs were present in the nursery blocks and from this and from later experiments with a view of determining the effect of the feeding of this pest upon peach buds, there can be no doubt but that in Missouri the tarnished plant bug is the source of its injury to young peach buds. The peach twig borer is often very troublesome in Missouri, especially on older trees but very little of its injury occurred in this nursery. The block of peaches found to be worst attacked stood alongside a forty-acre field of clover which was in full bloom when the writer visited the nursery. This clover was cut and cured a week later which evidently destroyed the majority of the eggs deposited by the tarnished plant bugs, for at no time later in the season were they so abundant in this field or in the nursery though in other fields they were plentiful all summer.

The writer has not had any opportunity of making a careful study of the early spring activity and development of this insect, but it would seem that on emerging from its winter quarters the pest is especially fond of the sap of peach and pear, but that after the first brood of eggs are deposited in the spring, the insect, like some of the orchard plant lice, prefers to feed upon the sap of other plants where the eggs are deposited, so that in this latitude at least it seldom returns to the nursery in destructive numbers.

The writer has had an opportunity of following the pest through the late summer and fall months and has learned a number of interesting facts with reference to the insect and its activities during that part of the year. It was found that the tarnished plant bug does not deposit its eggs in the tissue of plants as some maintain, not even in the soft stems of weeds. The ovipositor of the tarnished plant bug does not seem to be sufficiently strong to enable it to drill into tissues of plants. In this region it deposits its eggs, in the fall of the year at least, only in the blossoms of flowers such as daisies, asters, "mare's tail" (*Erigeron canandensis*), etc. This latter weed is used very largely for the depositing of eggs in the fall. The nymphs as well as the adults feed upon the sap of this plant during the months of August, September and October. They continue to breed upon it until the first heavy frosts have completely killed out the plant and driven them into winter quarters. It is not uncommon to find the pest feeding as late as the first of November upon plants in sheltered places. After frosts have destroyed most weeds and other plants one can find the tarnished plant bugs collecting in swarms around gardens, feeding upon the sap of turnips and other plants of this type which are more resistant to frost. During the winter they are

to be found by the thousands in and among the leaves of mullen plants where in this latitude they crawl about on warm days during the winter. Judging from the number of tarnished plant bugs which have gone into winter quarters, we may expect very severe injury to nursery stock in the spring.

A study of the development of the tarnished plant bug during the fall months has proven most interesting. In these studies the writer finds that the pest completes its cycle in thirty to thirty-five days during the months of September and October and he is of the opinion that during the summer months the life cycle is completed in from twenty to twenty-five days. It has been found that the pest has five distinct nymphal stages in place of four, as has always been maintained, therein agreeing with other closely related Hemiptera. It is not strange that the one nymphal stage has been overlooked by other workers, for it was not until a great many specimens had been followed from the egg through the first three nymphal stages, that the stage which has always been overlooked was finally discovered. The confusion is with the first three nymphal stages. The writer soon found that he had a nymph which in size, shape and markings did not agree either with the newly hatched nymph or the stage figured by other writers as the second nymphal stage. For a time it was considered as the early second stage but when it was found that it molted on assuming the form of the supposed mature second stage, it was clear that this was a distinct stage. This was confirmed over and over later with first stage nymphs. In a number of cases the writer has been able to carry individual specimens of the insect from the freshly laid egg through the five nymphal stages to the adult form. The life cycle and development of the tarnished plant bug will be discussed more in detail in another paper.

The subject of the control of the tarnished plant bug is one that deserves special attention for the injury to nursery stock alone is very considerable each year and the damage to vegetables and small fruits is not to be overlooked. This insect will probably never be controlled by any one method though by resorting to a number of simple methods of insect control it can be kept in check. During the late summer and fall all weeds and other blooming plants which provide a place for oviposition and food for the young and old insects should be carefully destroyed. Fence rows, roadsides and waste lands always furnish breeding grounds for this insect and they should be kept free from weeds, or all infested weeds should be sprayed regularly with a strong contact wash. Hundreds of tarnished plant bugs will mature on a single isolated weed during the summer months. In the winter all harboring places of the hibernating adults should be

burned over and mullen and other partially green plants which harbor the insects should be carefully destroyed. In the spring trap crops can probably be used to advantage in protecting nursery stock though this will require futher investigation. When the adult tarnished plant bugs are at work in the nursery a machine, provided with sticky shields, something similar to the one used for the apple leaf-hopper, is very effective in catching them. They are much more active than the leaf-hopper but where such a machine has been used in a nursery it catches thousands of the tarnished plant bugs. The writer is inclined to doubt the feasibility of protecting peach stock by spraying, at least with any of our present-day insecticides.

THE APPLE LEAF-HOPPER

(*Empoasca mali* LeB.)

By Leonard Haseman, *Department of Entomology, University of Missouri*

To nurserymen growing apple trees on an extensive scale this pest is often one of the most troublesome, especially in the more northern section of the Middle West. It has for years caused great trouble to nurserymen throughout the northern half of Missouri and in the last season or two has shown signs of becoming troublesome in the nurseries, even of the southern part of the state. In those nurseries where it has become established it is exceedingly injurious to the young stock and difficult to control. Aside from reports by Mr. Webster, issued recently by the Agricultural Experiment Stations of Iowa and Minnesota, we have little in the way of definite records concerning this pest, its life cycle and means of controlling it.

For the past two years it has been under observation by the writer in one of the larger nurseries of this state. We have not succeeded in making much progress relative to the life cycle and habits of the pest throughout the summer months, but we have determined some facts and have arrived at a definite scheme which seems to prove entirely effective in keeping the insect under control. We are told that the pest passes the winter in the egg condition under the bark of apple trees in the more northern states. From observations and experiments in Missouri it would seem that the pest is never carried over the winter in this condition, but, similar to the grape leaf-hopper, it passes the winter in the mature stage hiding about rubbish, along fence rows and under the foliage of such plants as docks, turnips and others, the foliage of which is not always completely destroyed by the first frosts of winter. Trees taken from the worst infested

portions of the nursery in which the work is being carried on were planted in breeding cages here at the Experiment Station and in no case were we able to rear leaf-hoppers from these trees. As a further evidence that in Missouri the pest is not carried over in the egg condition, one block which came under the writer's observation consisted of forty or fifty acres of one-year-old apples which had been severely injured two years ago by this pest. The winter of 1911 and 1912 was so severe that these trees were cut back to the ground before spring opened with a view of securing strong, healthy one-year-old trees on two-year roots. In the early spring of 1912 the writer examined this block when the pest first became noticeable throughout the nursery and while this block was several miles from apple orchards and in fact no fruit trees at all were within a mile of the ground, still it was found that these young trees, before they became half a foot tall were badly infested with very young nymphs and mature leaf-hoppers. The block under consideration was surrounded in part by woods and creek bottom land where an abundance of rubbish and leaves were collected in which the pest evidently passed the winter in great abundance and in the spring the adults simply moved back to the young growing trees and started the first colony of young.

The writer finds that in the early spring the first forms to appear are a few scattered adults. Following these is to be found usually a rather heavy brood of the young which are sufficiently abundant to seriously curl the first leaves. In a month to six weeks following this a second colony arrives and in a like period a third and so on until shortly before the leaves begin to fall. The later broods increase in numbers where measures are not taken to check them.

The writer has not been able to determine definitely with reference to the actual number of summer broods, but those which he has followed through seem to require from four to six weeks to complete their growth. In a nursery where the pest is uninterrupted one can usually determine from a single infested tree the number of times at which the heavy broods arrive from the fact that beginning near the ground is to be found a circle of curled leaves followed by fairly healthy foliage, succeeded in turn by another badly curled portion, and so on to the top of the tree.

From observations made before and after the first killing frosts this fall, it has been found that the adults leave the trees and collect along fence rows and in other protected places for the winter. The writer believes this will be found to be true throughout this state at least.

In reference to remedies for the pest it has been found impossible to control it entirely by the application of sprays. After a number of years of experience with spraying operations, the foreman of the

nursery in which the work is being carried on finds that while he has been able, at great expense, to prevent serious injury from the pest, he has not been able to control it completely. In view of the fact that the pest seems to pass the winter in the adult stage and arrives in the nursery to deposit eggs soon after the trees begin to grow, it occurred to the writer that a very thorough application of a contact wash in the spring to destroy the first brood of young might have a far-reaching effect upon the pest later in the season. With this in view a series of experiments with different washes was undertaken and from a comparative test of some eight or ten of these, it was found that the young nymphs could be readily destroyed with an oil wash. One of the commercial brands of miscible oils gave the best results. Probably the same results could be obtained by the use of a home-made kerosene emulsion, but this wash was not included in the comparative test this past spring. The kerosene emulsion has been the standard wash with this nursery firm for a number of years and the foreman found that it did not seem to be quite as effective as the miscible oil.

In order to control this first brood it is necessary to make three or four applications at intervals of from three to six days since the nymphs of the first brood do not appear at the same time. The first brood seems to be drawn out over two or three weeks. After carefully applying contact washes for this brood, spraying operations should be discontinued. The washes under consideration had little or no effect upon the stray adults which were found in the nursery during the application and spraying operations are too expensive to repeat throughout the summer at the necessary intervals to catch the nymphs before they become winged.

Following the early spraying this year a machine was run at intervals of three or four days with a view of catching as many of the winged adults as possible. This trap is built on the sticky shield plan, mounted on wheels and so adjusted as to enclose two rows of trees. The sticky shields extended forward to a point slightly in advance of the horse and are roofed over behind and sufficiently high on either side to prevent the escape of many of the insects. In this way the horse acts as an agitator and the back part of the machine is closed by suspending gunny sacks thereby preventing the escape of any great number of insects in that direction.

In the experiment carried on during the summer it was found that so many of the hoppers, tarnished plant bugs, and other insects of this type were caught upon the sticky surface of the machine that it was usually necessary to scrape and re-paint the machine twice each day

and during each cleaning of the machine from one to two or three gallons of insects would be removed.

This sort of machine can be run at very slight expense and in those blocks where it was run regularly during the summer it was impossible to find any signs of curled leaves due to the injury of the pest. The writer is of the opinion that if three or four applications of contact washes of the oil type are made at intervals of three or four days in the early spring when the first young nymphs appear and then follow this up during the summer with a machine for catching the adults, this pest can be controlled in any nursery at a very reasonable expense.

FALL SPRAYING FOR THE PEAR PSYLLA

By H. E. Hodgkiss, *Geneva, N. Y.*

Life history studies on the pear psylla were continued by the station during the past year for the purpose of determining more efficient methods for the control of this pest, and special attention has been given to the habits of the hibernating adults or "flies." Our investigations have shown that these individuals remain on the fruit spurs and young growth of the trees until the first severe cold weather occurs in November, when they seek the protection of the loose bark of the trunks and larger branches of the trees or hide under leaves or other débris which may be in the orchard. The roughened bark on adjacent trees of other kinds of fruits is often sought by them. If there is a warm spell during the late autumn and winter the "flies" become restive and abandon their sheltered places to gather on the lower branches of the trees, especially on the newer wood and fruit spurs. Whenever the weather moderates to a marked extent few of them remain in hiding, and where severe infestations exist myriads of the tiny insects cluster in the center of the trees. At such times the adults walk, but are sluggish in their movements and rarely attempt to jump or fly. The short duration of sunshine and the daily increasing cold cause a continual lessening of the activities of the insects, which become numbed and cling to the wood for considerable periods of time without exhibiting signs of movement.

The behavior of the hibernating psyllas in the *spring* is quite different from the habits of the insects in the *fall*. With the conclusion of winter the temperatures are constantly increasing and the daily effectiveness of sunlight is correspondingly longer. Coincident with moderation in the weather thousands of them leave their places of concealment and often a few hours of time are sufficient to effect great activity among the pests. It is not uncommon for them to jump and fly directly after emergence from their winter retreats.

The destruction of the hibernating "flies" is an important measure for the protection of pear orchards from psylla attacks. Careful spraying in the spring greatly reduces the numbers of the individuals and in some instances has completely freed plantings from the insects. The activity of the adults at that time has, however, prevented some growers from obtaining full control of this pest. It appears from the work that we have done that, on account of the difference in the behavior of the "flies" to gradually lessening temperatures, more favorable conditions exist in the late autumn for effective spraying.

During 1911 unprecedented numbers of psyllas entered hibernation, which afforded an excellent opportunity for demonstrating the value of fall treatments for the "flies." The experiments commenced on December 6 and continued until December 18, during which period thousands of the insects were clustered on the branches of the trees. The sprays applied were nicotine, fish-oil soap and lime-sulphur solution, used either separately or in combination. Nicotine preparations and soapy solutions were very effective. The lime-sulphur solution at dormant strength did not cause a marked reduction in the numbers of the psyllas, but with the addition of nicotine, the results from the combination compared favorably with the soapy sprays. Less than five per cent of the original infestation remained in the orchard at the completion of the work and in the following spring only scattering "flies" appeared upon the trees. In 1912 orchardists who were usually unable to control them by spring treatments found little difficulty in ridding their orchard of the insects through late fall applications of these sprays.

The success attending the *fall* spraying of pear orchards for the psylla is dependent upon,—(1) an understanding of weather influences upon the activities of the hibernating adults; (2) the complete wetting of each tree as the work proceeds; (3) thorough work in spraying.

THE 1912 OUTBREAK OF ALABAMA ARGILLACEA IN PERU

By Charles H. T. Townsend, *Lima, Peru*

During the first few months of 1912 the cotton leaf-caterpillar multiplied in extraordinary numbers in the cotton districts of the Peruvian coast region from about 9° to nearly 12° south latitude, and more or less unusually and generally to the northward as far as Piura Department. Complete defoliation occurred over the greater part of the districts from Chancay to Casma, reaching the latter valley on March 5. Much interest attaches to this outbreak from the fact that the meteorological conditions of the warm season of 1911–1912 in the coast region of Peru were very unusual.

The ordinary climatic conditions of the central Peruvian coast region from Chancay to Casma, in the low-lying cotton districts just back from the shore line, are as follows: June to November, very humid atmosphere, mist during nights and mornings, more or less continuous cloud-blanket, cool temperature; December to May, less atmospheric humidity in general with an approach to aridity during days, no mist, generally clear sky, warm but not oppressively hot temperature, cool ocean wind from south decreasing largely or dying out during the hottest part of the season.

The season of 1911–1912 showed the following abnormal conditions in this region: Very cloudy weather in general from November to March; an almost constant cloud-blanket from February 14 to 22, practically no sun, great atmospheric humidity with intensely oppressive heat, an unusually strong and very hot south wind continuing throughout the hottest season. This wind was evidently not the usual cool south wind from off the Humboldt ocean current, but a hot land wind from a general southeast direction that had followed up the coast line and whose origin was probably due to extra-local causes. It seems to have been strong enough to divert the south ocean wind from its usual course, or was perhaps itself a diversion of that wind, and was probably therefore responsible for the piling up of the unusual banks of humidity hanging over the coast line in this region.

It seems quite certain that the abnormal degree of humidity, with no sun, that prevailed during the last half of February, stagnated the soil of the irrigated fields by practically preventing the usual evaporation, while the abnormal heat caused a soil fermentation to set in, whereby neither the cotton plants nor the herbage in the fields showed any growth whatever from February 15 to March 21. The cotton plant was thus physiologically inactive for over a month during its usual period of greatest seasonal growth, and therefore still less prepared than ordinarily to withstand the attack of the caterpillar which was at its period of greatest activity. Irrigation during this period had no effect on the cotton plant, but rather made conditions worse.

The nights of March 21 and 22 were cold, with a sea-fog, and immediately after this sudden change in the meteorological conditions the cotton plants began to show signs of renewed activity. The herbage did not appear to resume growth till about March 30.

It seems indicated that the abnormal degrees of both heat and humidity which prevailed especially during February were most favorable to the rapid development of the caterpillar, resulting in an accelerated development of the stages of the insect, whose life-cycle seems to have averaged shorter than usual in North America, being reduced to about four weeks or even somewhat less. Three well-marked generations

were noted from January to March, and another was evident in April in certain districts. Thus there were at least five and perhaps six generations from December to April.

The abnormal fermentation of the soil, which was so pronounced as to sour the air in the fields, not only stopped the activity of the plants but probably killed a large part of the enemies of the caterpillar. The common *Eucelatoria australis*, one of the Compsilurine flies, was found commonly in the fields in April and was reared from the caterpillars. It does not go into the soil for pupation as a rule, while other muscoid species that probably attack the caterpillar enter the soil to pupate and were uncommon in the fields. Every detail of the complex of unusual conditions appears to have been exactly in favor of the caterpillar. The moths appear to have been carried to a considerable extent from one irrigated valley to another by the strong southeast wind already mentioned. The southernmost districts were the first to show decided injury, beginning early in January. The injury spread northward in a wave of increasing intensity during the next two months, while the greatest injury in some of the southernmost districts came later in April.

In the Casma valley, which is in the northern edge of the region of greatest defoliation, the caterpillar was noted as alarmingly abundant in isolated spots in the upper districts about the end of January. Fifteen days later there was a general infestation by spots, and active general defoliation began about the last of February and was completed about March 5. In the lower districts of the Casma valley, unusual multiplication of the caterpillar was not noted till February 9, and defoliation did not become complete. From March 5 to 21 there was practically not a leaf or sign of growth in the defoliated areas.

No arsenates were on hand in any quantity, and by the time the planters awoke generally to the importance of the outbreak, the caterpillar was so far advanced that little could have been done had poisons been available. The American Upland is the variety universally cultivated in all the districts in question, the yield being from 460 to 500 pounds lint cotton per acre. Some of the largest plantations in these valleys lost heavily by the caterpillar, one estimating its loss at £12,000. The Casma valley had about 3,500 to 4,000 acres in cotton, the loss by the caterpillar being over £20,000 on this acreage. The entire loss by the caterpillar in the Chancay to Casma districts, from January to April, is estimated at something over £70,000.

NOTES ON SOME MEXICAN SUGAR CANE INSECTS FROM SANTA LUCRECIA, STATE OF VERA CRUZ, INCLUDING A DESCRIPTION OF THE SUGAR CANE TINGID FROM MEXICO

By F. W. Urich, *Entomologist Board of Agriculture, Trinidad*
and Otto Heidemann

The sugar plantation on which I spent the months of August, September and October last year is situated about twelve miles from Santa Lucrecia on the Coatzacoalcos River. There are about 3,000 acres of canes under cultivation which were growing in a most luxuriant way and most of which were ratooning for the seventh time. (See Plate 7.) The climate of that part of Mexico was quite tropical and the fauna and flora reminded me often of those of Trinidad and northern South America. On the whole there were few insects that did much damage to the canes, in fact there was only one that called for serious attention and that was the Cercopid, *Tomaspis postica* Walk. It is reported that this insect has been known as a pest to grass lands of the State of Vera Cruz since 1880 and in 1903 was observed attacking sugar cane at Tantoyuca. The natural food plant of *Tomaspis postica* consists of grasses of several species, especially those growing in damp clay soils; from the grass it has spread to canes and there by the combined activity of the nymphs on the roots and the adults on the leaves, causes considerable damage when numerous and unchecked. Luckily it is controlled naturally by a parasitical fungus which also attacks [1]*Tomaspis varia* Fabr. in Trinidad, and which has been determined as *Metarrhizium anisopliæ* Metschnikoff. In some places a species of *Empusa* was also killing a good many of the adults. Unlike Fulgorids these Cercopids do not appear to have any egg parasites or parasites on the nymphs, at least I did not find any and have not been able to discover any records of such. A Reduviid bug, *Castolus plagiaticollis* Stal. (det. Heidemann) was very common in the fields where *T. postica* was numerous and many adults were to be seen carrying around these Cercopids impaled on their proboscis. Unfortunately the eggs of *Castolus* were attacked by a species of *Telenomus* (det. Crawford). The old cane pest, *Diatræa saccharalis*, was not wanting and there was a second stalk borer present which Dr. H. G. Dyar has determined as *Diatræa grandiosella* Dyar. It cannot be said that either of these were very serious pests. It was not an easy matter to find egg masses of these moths in the

[1]In my "Notes on some insect pests affecting the sugar cane" Journal of Ec. Ent. Vol. 4, p. 225, I refer wrongly to this insect as *T. postica*.

cane fields, but the only two that were found were parasitized; *D. saccharalis* by *Trichogramma pretiosa* Riley (det. Howard) and *D. grandiosella* by a *Telenomus* sp. (det. Crawford).

Dr. Dyar has been good enough to draw up the following description of the larva of *Diatræa grandiosella* Dyar:—

Head rounded quadrate, narrowing a little below; clypeus high; para-clypeal pieces reaching about two-thirds the height of the front; pale orange-brown; a little darker on the vertex, median and para-clypeal sutures whitish; clypeal sutures dark, mouth black, the color covering the epistoma and bases of maxillæ; ocelli with black central dots, a patch of black covering the lower ocelli; labium and palpi pale; a black triangular spot at side of occiput near the middle; setæ rather coarse, pale, without visible tubercles. Body cylindrical, elongate, moderately robust, tapering posteriorly but only slightly so anteriorly. Thoracic feet moderate, pale brownish, like the head with smoky patches before and behind; abdominal feet very short, thick, the crochets in circles, anal feet somewhat longer, their circle of crochets broadly broken behind. Color whitish with a broad purplish shaded subdorsal stripe, which is quite faint and blotched in the fully grown larvæ. Tubercles large and conspicuous, blackish brown, I larger than II, IV and V forming a single tubercle, VII an elongate patch; on the thorax a narrow chitinous band on the posterior edges of joints 3 and 4 dorsally; tubercles Ia and Ib, IIa and IIb, III and IV, VI with two setæ. Cervical shield large, containing six setæ on each side, pale brown like the head with a pale dividing dorsal line; a small black stain on the lateral margin, otherwise unmarked. Joint 13 rather distinctly divided, its anterior part with the subdorsal tubercles joined over the back by a black stain; anal plate pale reddish brown with three setæ on each side, irregularly joined by brown stains, the plate appearing bimaculate."

Canes damaged by the Gopher (*Heterogeomys hispidus* Le Conte) called "Tuza" in Mexico often contained larvæ of *Metamasius sericeus* Latr. var. *carbonarius* Chev. (det. Schwarz) but in no case was this beetle observed attacking perfectly healthy canes. When the canes were fermenting, from damage done by Gophers or *Diatræa* sometimes they were attacked by *Xyleborus affinis* Eichf. (det. Lt.-Col. Winn Sampson) but this Scolytid was never observed in sound stalks. A Tingid, *Leptodictya tabida* Champ., which Mr. Heidemann has been good enough to describe and figure was not very numerous, and although it damaged the cane leaves in the characteristic way of this family, it cannot be considered a pest at all. The grassy spaces between the fields of canes harbored a great many grasshoppers of different species, some did trivial damage to the cane leaves, but were never numerous enough to make their presence felt. The following genera were represented: *Machærocera*, *Tæniopoda*, *Schistocerca* and *Neoconocephalus*. No doubt these grasshoppers are kept in control by natural enemies, among which there were many insectivorous birds.

The sugar cane leaf serves as food for many caterpillars but at the

Oxaguena Plantation. Mexican ribbon cane, planted 14 months.

time I was there none appeared to be doing any damage. Among the Lepidoptera that were bred from caterpillars I may mention a Syntomid, *Cyanopepla submacula* Walk. (det. Dyar). The Skipper *Perimeles remus* Fabr. was very common in the fields. A few caterpillars belonging to the genus *Cirphis,* which commonly eat the unfolding leaf of the cane were attacked by the parasite, *Horismenus urichi* Crawford (det. Crawford). From the eggs of an undetermined Fulgorid imbedded in the tissue of a cane leaf, I reared a giant Mymarid which turned out to be *Cosmocomoidea morrilli* Howard (det. Howard).

There were numbers of lizards of different species in the fields, which do good work in keeping down insects of all kinds. On reference to Plate 7 it will be readily understood how impossible would be artificial control, such as spraying in a sugar cane field, when canes are any size at all. The only time of the year would be when the canes have just commenced to grow, but then two difficulties crop up, the scant labor supply and the large areas to be treated at one and the same time. Planters must therefore rely on natural control and in Mexico there is a fair amount of it by insects and fungi.

My thanks are due to Dr. Howard and his assistants and to Lt.-Col. Winn Sampson for determinations.

THE SUGAR-CANE TINGID FROM MEXICO

By Otto Heidemann

This neat little hemipterous insect was originally described as *Monanthia tabida* and figured by Herrich Schaeffer 1839, habitat Mexico. F. K. Fieber copied Schaeffer's description and figure in his "Monographie der Tingideæ," 1844. Later, about 1900, Dr. G. C. Champion found specimens of this species also in Panama and Guatemala and redescribed and figured the same in the *Biologia Centrali-Americana,* but referred the species to the genus *Leptodictya,* which had been erected by Stal, 1873, based on some South-American species.

Notwithstanding the fact, that, the characters of the species already are well defined, the writer ventures to give a new description more in particulars.

Leptodictya tabida (H. Schaeff.) Champion.[3]
Monanthia tabida Herrich Schaeffer.[1]
Monanthia tabida Fieber.[2]

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[1] Wanzenartigen Insecten, V, p. 86, t. 173, fig. 535. (1839).
[2] En. Monogr. Tingideæ, 1884, p. 70, t. vi, fig. 1.
[3] Biol. C. Am. II, p. 23, t. 2, fig. 10. (1897–1901).

Body elongate oblong, very flat. Head short with five slender spines, those in front nearly extending to beyond the second antennal joint, the other two diverging from the base of head somewhat upwardly. Eyes rather small, globular, reddish, strongly faceted. Buculæ minutely reticulated, the edge hardly upturned. Sides of rostral groove moderately raised; rostrum not quite reaching the metasternum. Antennæ long and rather thin; basal joints about as long as the apical, which is fusiform; second joint very short; third, four times as long as the fourth. Pronotum narrowing anteriorly, the disk hardly convex, with three linear, low carinæ; interspaces finely punctured; the triangular posterior portion of pronotum quite long, pointed at apex, the surface depressed, closely reticulate; the expanded lateral margins of pronotum are formed by two layers of membrane joined together on the outer edge (viewed sideways) which is cut straight and rectangular anteriorly, the lateral margins are somewhat opaque and have two rows of small areoles. Hood short and with a sharp carina on top, projecting a little in front, but not covering the head, finely reticulated. The elytra transparent, elongate-oval in shape, extending to far beyond the abdomen, the sides feebly rounded, narrowing slightly toward the apex; discoidal area very long, reticulate, the inner nervure, bounding the area, more sharply defined than the outer one, another smaller vein passes along the disk nearly parallel to the inner nervures; subcostal margins narrow, biseriate, costal margins a little broader than the discoidal area with irregular rows of hexangular areoles, those nearing the apex of elytra larger; at the sides anteriorly three or four transverse depressions or folds. Integument pale stramineous; pronotum and abdomen ochraceous; antennæ and legs yellowish-white, claws black. Length 3.8 mm.; width across the widest part of elytra 1.6 mm.

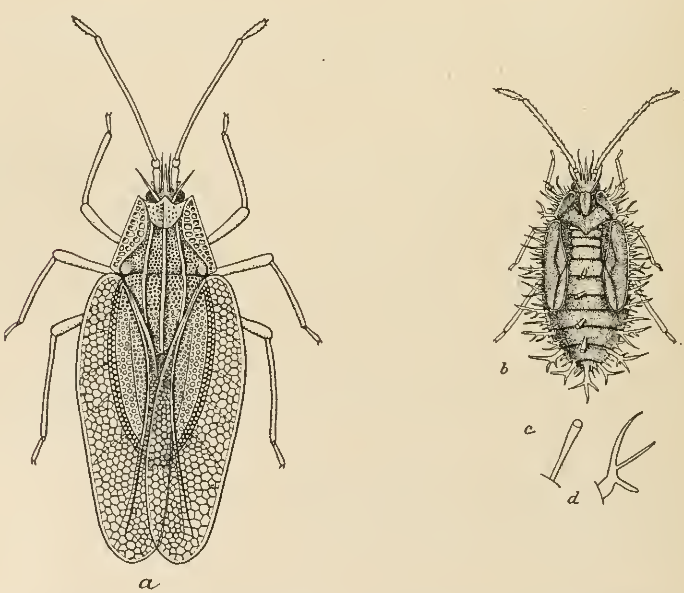

Fig. 1. *Leptodictya tabida*, *a*, adult; *b*, nymph of same; *c*, club-shaped process; *d*, lateral abdominal branched-spines.

Description of the nymph.—Body oblong, rather flat, yellowish-white, densely covered with erect white spinules. The head shows five single very prominent spines. Lateral expansion of the pronotal margins and the sides of body armed with stout, whitish, branched-spines, which are irregular in shape, and at the interspaces are some shorter, single ones. Wing-pads quite long and the posterior triangular portion of pronotum very short. Dorsal part of body ornamented with some peculiar club-shaped processes, which show distinctly an opening at apex. Legs and the underside of body whitish, Antennæ pilose. Length, 2 mm.; width, 1 mm.

Described from several specimens collected by Mr. F. W. Urich on Sugar Cane at Santa Lucrecia, State of Vera Cruz, Mexico, September, 1911.

This species can be distinguished at once by the straight margin of the lateral expansion of the pronotum, which is in the other Central-American species more or less rounded.

THE INSECTS AFFECTING SUGAR CANE IN PORTO RICO[1]

By D. L. Van Dine, *Entomologist, Experiment Station, Porto Rico Sugar Producers' Association, Rio Piedras, P. R.*

Sugar cane has been cultivated in the island of Porto Rico for nearly 400 years. It is only within the last half of the past century, however, that insect pests have been noted affecting the crop and only within very recent years that certain species of insects have given concern to the sugar-cane planters. Those best informed on the subject believe that the sugar-cane moth stalk-borer, *Diatræa saccharalis* Fabr., was introduced into the island in seed cane brought from the British West Indies. It is probable that other species, previously unknown in the island, were introduced in a similar manner, as for example, the leaf-hopper, *Delphax saccharivora* Westw.; the weevil stalk-borer, *Metamasius hemipterus* Linn.; the mealy-bug, *Pseudococcus sacchari* Ckll.; and the scale-insect, *Targionia sacchari* Ckll. Some of these species have appeared in the cane fields within the memory of those engaged in the growing of sugar cane at the present time and the evidence points to their having been introduced into the island along with shipments of their host plant.

When this station was organized a little over two years ago by the Sugar Producers' Association of Porto Rico, the study of the insects affecting sugar cane was one of the lines of investigation provided for.

The writer is indebted to Señor Agustín Navarrete for the loan of a copy of Dr. A. Stahl's "Fauna de Puerto-Rico" which was published

[1] Published by permission of Mr. J. T. Crawley, Director, Experiment Station, Porto Rico Sugar Producers' Association.

by the author in 1882,[1] thirty years ago. Dr. Stahl records the sugar-cane weevil stalk-borer, *Metamasius hemipterus* Linn., under the name *Sphenophorus sericeus* Latr.; the southern grass-worm, *Laphygma frugiperda* S. & A.; and the mole-cricket, *Scapteriscus didactylus* Latr., under the name, *Gryllotalpa hexadactyla*.

Some seventeen years ago the insects affecting sugar cane in Porto Rico were reported upon by Señor Fernando Lopez Tuero, director of the local Agronomical Station of the Spanish Government, existing at that time in the town of Rio Piedras.[2]

The moth stalk-borer, *Diatræa saccharalis* Fabr., is recorded by Señor Tuero under the common name of "borer" or "gusano de la caña" and under the technical name of *Tortrix sacrifaga*. The mole-cricket, *Scapteriscus didactylus* Latr., is discussed under the common name of "la changa" and the scientific name *Gryllotalpa* sp. The sugar cane mealy bug, *Pseudococcus sacchari* Ckll., is called the "piojo de bolsa blanca" or "queresa" and is determined as *Coccus sacchari*. The May beetle, *Lachnosterna* sp., of the sugar cane is recorded as belonging to the group Melolonthides and is given the common name of "caculo" and the white grub of the same is called the "gusano blanco." The report deals with the habits of the insects, the nature of their injury to the cane, their natural enemies, and the methods of control. It is a most interesting and instructive discussion of the insects known to affect sugar cane in Porto Rico at that time. At the end of the discussion of the insects is given information on injury to cane by rats, the history of the introduction of the mongoose to destroy the rats, the injury by the land-crab, and by live-stock. On pages 105–123 of the report, under the title "Enfermedad de la Caña de Azúcar," the history of the injury to cane by the white-grub of the May-beetle is given and the results of extended investigations on the nature of the injury and remedies are discussed. Altogether the report is a valuable contribution to the subject of Porto Rican sugar-cane insects.

Dr. W. Kruger records the West Indian sugar-cane leaf-hopper, *Delphax saccharivora* Westw., from Porto Rico in a footnote on page 312 in his "Das Zuckerrohr und seine Kultur," published in 1889.

In 1900 Mr. A. Busck[3] records the mole-cricket under the common name of "changa" and states that Dr Stahl of Bayamon determined

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[1] A. Stahl. Fauna de Puerto-Rico. Clasificacion sistemática de los animales que corresponden à esta fauna y catalogo del Gabinete Zoölógico. 1882. Insectos, pp. 82–102; 169–213.

[2] La Caña de Azúcar en Puerto-Rico, su Cultivo y Enfermedad. Por Fernando Lopez Tuero, Rio Piedras, 1895. Capítulo IV, Enemigos de la Caña y Modo de Combatirlos, pp. 63–74. Enfermedad de la caña de azúcar, pp. 105–123.

[3] Notes on a Brief Trip to Puerto Rico in January and February, 1899. Bul. 22 (n. s.), Bur. Ent., U. S. Dept. Agr., 1900, pp. 88–93.

the species for him as *Gryllotalpa hexadactyla*. Mr. Busck mentions *Diatræa saccharalis* Fabr. as being quite bad in some localities and he records the weevil stalk-borer, *Metamasius hemipterus* Linn., under the name *Sphenophorus sexguttatus* Drury. The sugar-cane mealy-bug, *Pseudococcus sacchari* Ckll., is included in Mr. Busck's report and, in further reference to sugar-cane insects, he states that there is "a lamellicorn larva common and destructive to the roots," referring no doubt to the white-grub of the common May-beetle, *Lachnosterna* sp.

In 1902 Mr. O. W. Barrett published a bulletin dealing with the mole cricket or "la changa" in Porto Rico.[1] Mr. Barrett's bulletin is a general account of the life-history, habits, food plants and methods of control of the species in Porto Rico.

In the annual report of the Porto Rico Agricultural Experiment Station, Mayaguez, for the year 1906, Mr. W. V. Tower mentions (page 28) the injury to sugar cane by the moth stalk-borer, *Diatræa saccharalis* Fabr. In the report of the same institution for the year 1907 (pages 36 and 37) Mr. Tower refers to mealy-bug injury to sugar cane and records the shot-hole stalk-borer, *Xyleborus* sp., and the weevil stalk-borer, *Metamasius hemipterus* Linn., under the name *Sphenophorus* sp. May-beetle injury to cane is mentioned by Mr. Tower in the report of the Mayaguez Station for the year 1909 (pages 25 and 26). In the latter report Mr. Tower says: "The larva of one of the Lachnosterna beetles is causing a great deal of damage to the roots of sugar cane; in many instances the tonnage of certain areas has been decreased by its destructive work."

The writer has recorded and discussed the insects affecting sugar cane in Porto Rico in the 1st and 2d Annual Reports of this station.[2] The damage to sugar-cane juice by the moth stalk-borer, *Diatræa saccharalis* Fabr., was reported upon by the writer in a circular of this station published in 1912.[3]

The following is a brief summary of all the species of insects found affecting sugar cane during the two years the entomological investigations of this station have been in progress. The determinations have been made, with few exceptions, by the specialists of the Bureau of Entomology, United States Department of Agriculture, through the kindness of Dr. L. O. Howard, Chief of the Bureau. The entomological investigations of this station are in direct coöperation with

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[1] The Changa, or Mole-Cricket (*Scapteriscus didactylus* Latr.) in Porto Rico. Bul. 2, Porto Rico Agr. Expt. Sta., U. S. Dept. Agr., 1902, pp. 19, fig. 1.

[2] 1st Ann. Rpt. (Bul. No. 1), Expt. Sta., Porto Rico Sugar Producers' Ass'n, for the year 1910–1911, 1911, pp. 17–31.

2d Ann. Rpt. (Bul. No. 2), Expt. Sta., Porto Rico Sugar Producers' Ass'n, for the year 1911–1912, 1912, pp. 15–22.

[3] Circular No. 1, Expt. Sta., Porto Rico Sugar Producers' Ass'n, 1912, pp. 11.

the work of the United States Bureau of Entomology on the insects affecting sugar cane in the southern United States.

The moth stalk-borer, *Diatræa saccharalis* Fabr., is generally distributed over all the cane areas in the island and the species is responsible for the greatest amount of damage of any insect attacking sugar cane in Porto Rico. The species was determined for the writer by Dr. H. G. Dyar. The Spanish equivalent for the common name of the insect is "el barreno-polilla del tallo de la caña." The local natural enemies of the sugar-cane moth stalk-borer observed to date are: an egg-parasite, *Trichogramma pretiosa* Riley (?); a Tachinid fly, *Tachinophyto* (*Hypostena*) sp., collected from the gallery of the larva by Mr. T. H. Jones at Rio Piedras, determined by Mr. W. R. Walton; and the fungus parasite, *Cordyceps barberi*, determined by Dr. R. Thaxter of Harvard University.

The injury to the roots of sugar cane by the white-grubs of May-beetles, *Lachnosterna* spp., is the most acute insect pest problem before the Porto Rican sugar-cane planter. The several species involved have been referred to Mr. E. A. Schwarz, who states that some of them are new. Aside from the *Lachnosterna* one other species of the sub-family *Melolonthides* has been collected from the cane field, as well as several species of the related sub-family *Dynastides*, that is, the so-called "hard back" and Rhinoceros beetles. One of the cane field hard-back beetles is a species of the genus *Ligyrus*. The Spanish equivalent for the common May-beetles is "el caculo moreno nocturno" and for the white-grubs, "el gusano blanco." The hard-backs are called "el caculo negro nocturno." The local natural enemies of May-beetles are the wasp, *Campsomeris dorsata* Fabr., bred from the larva of a *Lachnosterna* collected by Mr. C. T. Murphy of Guanica Centrale, determined by Mr. S. A. Rowher; the wasp, *Elis sexcincta* Fabr., collected from flowers by Mr. T. H. Jones, determined by Mr. Rowher; two species of Tachina flies, the first collected by the writer in company with Mr. B. H. Doidge, Manager of the Pagan sugar estate of Guanica Centrale, and the second collected by Mr. T. H. Jones, referred to by Mr. W. R. Walton;[1] and the blackbirds known

[1] Since the above was written Mr. Walton has determined the Tachina fly collected by the writer and Mr. Doidge to represent a new species and the species collected later by Mr. Jones to represent not only a new species but also a new genus. The former species, taken on April 29, 1912, has been described by Mr. Walton under the name *Cryptomeigenia aurifacies* in the Proceedings of the Entomological Society of Washington, Vol. XIV, 1912, pp. 198–200. The latter species taken by Mr. Jones on May 14, 1912, has been described by Mr. Walton under the name of *Eutrixoides jonesii* in Entomological News, Vol. XXIV, No. 2, 1913, pp. 49–51. Both of these flies were discovered at the Librada coffee plantation, Añasco valley, Porto Rico, as parasites within adult *Lachnosterna*.

locally as "el Judio," *Crotophaga ani* and "el chango" or "mozambique," *Holoquiscalus brachipterus*, determined by Prof. H. W. Henshaw of the Bureau of Biological Survey. Dr. Stahl in his "Fauna de Puerto-Rico" (page 199) records the wasp, *Campsomeris dorsata* Fabr., under the name *Scolia dorsata* Fabr. and the wasp, *Elis sexcincta* Fabr., under the name *Myzine sexcincta* Fabr.

The mole-cricket, *Scapteriscus didactylus* Latr., known locally as "la changa," is common over all the island and is injurious to practically all cultivated plants. Because of the widespread injury of this insect and the variety of its food-plants, it is the most commonly known insect pest in Porto Rico. Fortunately, the injury to sugar cane by the mole-cricket is restricted to the germinating seed cane cuttings and to the young shoots, that is, it does not feed upon sugar cane during the entire growth of the plant. The insect eats into the seed cane after planting and destroys the eye or, more commonly, eats into the base of the young shoot, just beneath the surface of the ground. The symptom of the injury is very similar to that caused by the work of the sugar-cane beetle, *Ligyrus rugiceps* Lec., in young cane in the southern United States. As soon as the young cane shoot has attained some height, and has hardened somewhat, the mole-cricket does not appear to damage the crop further. A further restriction to injury by the mole-cricket is the fact that the insect can work readily only in sandy or loose soils and the cane planted in the heavier clay soils escapes serious injury. The alluvial deposits along river banks and the loose, sandy soils on a plantation are known as "changa" lands. Señor Fernando Lopez Tuero, in his report previously referred to, states that the term "la changa" is the name used in Porto Rico for the reason that the head and fore part of the insect are the shape of a monkey. Señor Tuero says, regarding natural enemies: (Translation) "In the natural struggle for existence, the lizard, which is so abundant in the fields, is an important factor in the destruction of the mole-cricket. The mole-cricket's safeguard consists in its staying hidden during the day, but those which come out of the ground, or, which for any reason, are discovered by their enemy, die immediately.

"Birds and domestic fowls also eat many insects when they are able to find them. The fowls of the plantation, in hunting for their living, always follow the furrow of the plow in order to eat the larvæ of insects and, when they find a mole-cricket, they rush upon it and devour it with preference. The 'mozambique', and many other birds, have the habit of following the furrow of the plow."

The sugar-cane mealy-bug, *Pseudococcus sacchari* Ckll., is found on every sugar-cane plantation in the island. It attacks the cane throughout its growth but the most serious injury noted has been to the roots

of young cane beneath the surface of the ground. The mealy-bug appears to be taken into the cane fields on the seed cane and to develop below the ground about the young and tender roots until the cane stalk has formed sufficient inter-nodes above the ground for the pest to find shelter, at the nodes, beneath the leaf-sheaths. The species was determined as (?) by Mr. E. R. Sasscer. The local natural enemies are the parasitic fungus, *Aspergillus* sp., determined by Mr. J. R. Johnston, pathologist of this station; and the Australian lady-bird beetle, *Cryptolaemus montrouzieri* Muls., introduced by this station in coöperation with the United States Bureau of Entomology. The fire-ant, known locally as "la hormiga brava," *Solenopsis geminata* Fabr., and the ant, *Prenolepis fulva* Mayr., determined by Dr. William M. Wheeler of Bussey Institution, are associated with the mealy-bug in the cane fields, the former species being the more common. The local equivalent for the sugar-cane mealy-bug is "el piojo de bolsa blanca" or "la queresa de la caña."

The West Indian sugar-cane leaf-hopper, *Delphax saccharivora* Westw., is not abundant in Porto Rico but is widely distributed over the island. The common name has been given the Spanish equivalent of "el salta-hoja de la caña de las Antillas." The species was determined for the writer by Mr. O. Heidemann. An egg-parasite, *Mymaridæ*, undetermined; an external parasite, *Dryinidæ*, of the nymph and adult; and a parasite, *Strepsiptera*, of the nymph and adult, have been bred from this species. The egg parasite was collected by the writer and the parasites of the nymph and adult by Mr. Jones.

The West Indian sugar-cane weevil stalk-borer, *Metamasius hemipterus* Linn., has been collected in all of the cane districts in the island but has been observed in injurious numbers in restricted areas only. The species was determined by Mr. E. A. Schwarz. This insect has been given the Spanish common name of "el barreno-gorgojo del tallo de la caña de las Antillas." A weevil root-borer, *Diaprepes* sp., has been found breeding at the roots of cane in several localities. Mr. Schwarz states that this local weevil root-borer is not identical with the sugar-cane weevil root-borer recorded from Barbados by Ballou under the name *Diaprepes abbreviatus*. The weevil root-borer attacks the root-stalk of the plant.

The shot-hole stalk-borer, *Xyleborus* sp., determined as representing a new species by Dr. A. D. Hopkins, is generally distributed over the cane areas of the island. The Spanish equivalent of the common name is "el barreno-agujereador del tallo de la caña." The local observations support the idea that this insect attacks only diseased canes. It is usually associated with the rind disease of the sugar cane, determined by Mr. Johnston as *Melanconium sacchari*.

The cane in Porto Rico is attacked by two species of aphids, the common species being *Sipha graminis* Klt., determined by Mr. Theo. Pergande. Mr. Jones has made a study of the common sugar-cane aphid and has found the following lady-bird beetles feeding upon it; *Cycloneda sanguinea* Linn., *Megilla innotata* Vauls., *Scymnus loewii* Muls., and *Scymnus roseicollis* Muls. The lady-bird beetle determinations are by Mr. Schwarz. Mr. Jones has also collected the larvæ of a Syrphid fly and of a Chrysopid feeding upon the cane aphid, both species being at the present time undetermined.

The southern grass-worm, *Laphygma frugiperda* S. & A., is very often injurious to young cane in Porto Rico, especially after rains, and usually occurs in company with another grass-worm, *Remigia repanda* Fabr., though the former species is the more abundant. These pests are known locally as "los gusanos de yerba." The occurrence of these grass-worms on sugar cane in Porto Rico is the subject of a paper for presentation at this meeting by Mr. Thomas H. Jones, assistant entomologist of this station. Other caterpillars which attack sugar cane in Porto Rico are the larvæ of *Cirphis latiuscula* H. S., another Noctuid; and of *Prenes nero* Fabr., an Hesperid. The determinations of the above lepidoptera were made by Dr. H. G. Dyar. Three species of Tachina flies, namely *Frontina archippivora* Will., *Gonia crassicornis* Fabr., and *Archytas piliventris* v. d. W., determined by Mr. W. R. Walton, have been bred from the larvæ of *Laphygma frugiperda* and a Braconid parasite has been bred from the larva of *Cirphis latiuscula.* Blackbirds feed upon these caterpillars, especially in the more open grass lands.

The sugar-cane scale-insect, *Targionia sacchari* Ckll., determined by E. R. Sasscer, is rather common on cane in Porto Rico, occurring on the stalks, but appears to do no particular damage. The Spanish equivalent for the common name is "el insecto escamoso de la caña."

The adult of *Diabrotica graminea* Balz., known commonly as the green Diabrotica, is found feeding upon the cane leaves. The breeding habits of the species are not known. The determination is by Mr. Schwarz.

A Jassid, *Tettigonia similis* Walk., is found very frequently upon the leaves of sugar cane in Porto Rico but the breeding habits of the insect have not as yet been observed. The species was determined by Mr. O. Heidemann.

Several instances of injury to seed cane after planting by termites have been noted. This species is known locally as "el comején." It is recorded by Dr. Stahl in his "Fauna de Puerto-Rico" (page 207) under the name *Termes morio* Lath.

A leaf-hopper, *Ormenis* sp., has been found breeding on cane leaves in one instance and an undetermined bud-moth (*Tineidæ*) is found at times infesting the cane in rather isolated areas.

Proceedings of the Eleventh Annual Meeting of the American Association of Official Horticultural Inspectors

(*Continued from page 142*)

Chairman E. L. Worsham, of the Horticultural Inspection Section, has appointed the following committees.—[Ed.]

Committee on Standardization of Certificates

A. W. Morrill, *Chairman*, Phoenix, Ariz.,
F. L. Washburn, St. Anthony Park, Minn.,
Franklin Sherman, Jr., Raleigh, N. C.

Committee to Get out a Publication

Dr. W. E. Britton, *Chairman*, New Haven, Conn.,
Dr. T. J. Headlee, New Brunswick, N. J.,
N. E. Shaw, Columbus, Ohio.

REMARKS ON GIPSY MOTH

By A. F. Burgess, *Member Federal Horticultural Board*

Mr. President, and Members of the Association: I do not know that I can add very much to what has already been said in regard to the work of the Federal Horticultural Board. As I am located in Massachusetts and have been for several years especially interested in the gipsy moth control work, it might be of interest to some of the members of the Association to learn what is being done to prevent the gipsy and brown-tail moths from spreading to other parts of the United States. After the passage of the Plant Quarantine Law the matter of establishing a quarantine in this section was considered by the Federal Horticultural Board and on November 25, 1912, after public hearings held at Washington, the quarantine was established. Enforcement of the quarantine regulations are in charge of Mr. D. M. Rogers, who is superintendent of moth work for the Bureau of Entomology. The territory has been divided into sections and Mr. Rogers has placed a competent inspector in each section whose duty it is to examine all lumber and forest products which are shipped from that section to points outside the infested territory. Certificates are issued covering such shipments and as transportation companies are prohibited from accepting material of this sort, which is destined to points outside the quarantined area unless accompanied by a certificate of inspection, it is obvious that the country at large is securing ample

protection. All nursery stock going outside the district is examined by federal inspectors or state inspectors who are deputized to act in that capacity so that the spread of the insect is safeguarded when goods of this character are shipped. Some complaint was made during the fall because Christmas trees and greens were not allowed to be shipped to points outside the quarantined area, but as it is practically impossible to make an adequate inspection of this class of material, it was necessary to prohibit such shipments. Some confusion has arisen in regard to the provisions of the quarantine, but for the most part it is working out very satisfactorily and cannot fail to safeguard remote sections of the country from possible introduction of these insects from the infested area. This quarantine is only one of the many beneficial results of the passage of the federal act.

NOTES ON INSPECTION

By F. L. Washburn, *St. Anthony Park, Minn.*

The leading points intended to be presented to you in this paper have been practically covered by our discussion with the Quarantine Board last evening. I believe that all of us as inspectors have reason to congratulate ourselves upon the passage of the federal quarantine bill. It gives our actions as inspectors of various states a substantial and authoritative backing never before experienced. This is not only true of inspection of foreign stock, but inspection of domestic stock as well, since nurserymen, rather than see their state or a part of it quarantined will welcome rigid inspection on the part of state officials.

Minnesota has had, apparently, judging from the discussion last evening, the same experience as many other states under the working of this new law. We have found during the last year occasional shipments for which we had received no notice, and also, occasionally apparently more than one notice for the same shipment, and we have sometimes been at a loss to know what shipment was referred to by a notice from the quarantine board, not having upon its face any reference to identification marks. We have further received one or two notices referring to bulbs and bulbs alone, which we understand are not included in the outline of the work of the quarantine board. We feel that the work would be very much strengthened if marks on the packages and their contents were placed upon each notice sent from Washington; but we all realize that it takes a little while for a new law to become established, and I have no doubt but that another year will find the machinery in such good working condition that there will be no delay or confusion or embarrassment of any kind.

In order to conform to this federal law, we propose to have enacted in Minnesota this winter if it is a possible thing, a much more stringent law than we have at present. Under the present law the entomologist only inspects nurseries upon request, or when he has reason to suspect the presence of injurious insects, but even in that event, he can only inspect stock upon premises where it is grown for sale. He is absolutely powerless with reference to private individuals, estates, parks, etc.

Two matters have come to our attention as inspector during the season just passed which are worthy of comment and may have been experienced by officials in other states. In the first instance two or more dealers in a Minnesota city who shipped goods directly from some other state to a patron and, not desiring to advertise the firm from whom they bought these goods, asked us in order that they might conform to the law, to furnish them with a Minnesota certificate signed by the Minnesota official to the effect that this stock was inspected where grown. This request had to be denied, naturally, and we explained to them that the Minnesota official could have no authority outside of Minnesota, and that their difficulty was purely a trade matter which they would have to arrange for without the cooperation of the Minnesota inspector.

The second matter to which I refer is of much more serious import, and one of such a character as to call for some discussion by members of this Association. In connection with the affair just referred to, I found that officials in two Eastern states were certifying that certain dealers in Minnesota owned nurseries in the Eastern states referred to. This testimony was signed by prominent officials and the statements were, of course, absolutely false. I have since learned that this condition of affairs has come to the notice of other inspectors beside myself.

The need of properly qualified inspectors is a fact of growing importance impressed upon us each year. We have been asked by various states to recommend or furnish men for inspection services but we are seriously put to it ourselves to get men properly qualified to take care of our own work in Minnesota, and so serious is the situation that we contemplate establishing a special course in our college curriculum for inspectors. It is evident that deputies sent among nurserymen must be mature men. It injures our work seriously to send boys, or those whom nurserymen might regard as boys to do this work. Further, no matter how efficient an inspector may be as an expert in detecting injurious insects or contagious plant diseases, if he is not able to discuss methods of spraying, different insecticides and spraying machinery in a helpful way with nurserymen and orchardists, he is hardly acceptable to them as an inspector. In other words, an inspector must be an "all around man."

COÖPERATION BETWEEN STATE HORTICULTURAL INSPECTORS

By A. W. Morrill, *Phoenix, Ariz.*

It is not the writer's intention to present in this paper a comprehensive scheme for coöperation among those in charge of state horticultural inspection affairs. Rather he frankly confesses to the narrowness of his experience in this line of work and to his lack of a thorough knowledge of the problems of most of his fellow-workers in other states. This paper is prompted principally by certain problems which confront the inspection service in Arizona—problems, however, which are not peculiar to Arizona, but which the writer is prepared to discuss particularly from the standpoint of the arid southwest.

During the first year's operation of the Horticultural Inspection law in Arizona, the records of our inspection of imported plants showed 8.6 per cent of the shipments from other states to be infested with insect pests. The second year's operation showed a decrease in infested shipments to 6.4 per cent and the third year's to 4.2 per cent. The writer believes he is not ungenerous in ascribing this improvement of conditions not to a reduction in the numbers of insect pests in the nurseries and other plant shipping establishments or to increased efficiency of the officials in other states, who furnished the certificates of inspection, but to the simple spread of knowledge among nurserymen, florists and other plant shippers concerning Arizona's requirements. It is our experience that it is important that information be placed in the hands of not only those who are now shipping plants into the state but those who may do so in the future, in order that they may comply with our requirements, or if impossible to do this, that they may protect themselves by refusing orders from our state. The fact that we propose to inspect all shipments of plants coming into the state affects only in a degree the desirability of having infested shipments kept out. In spite of the best endeavors on the part of common carriers to keep all of their new, as well as old employees informed concerning the matter of holding plants for inspection, occasionally a shipment will be delivered without awaiting for the inspector's release. This is especially likely to occur when the packages, boxes or bundles are not properly labeled to indicate the true contents. It is therefore important, as a matter of protection, that every practicable effort be made to reduce the number of infested shipments entering a state even in the case of those states where shipments of plants are inspected at destination.

Means for Informing Shippers of Plants Concerning State Requirements

In this connection, the writer proposes that this Association provide for an annually revised circular of information containing, in as concise form as practicable, the exact requirements of each state, which are of interest to shippers of plants, and agricultural and horticultural products. The information should include the restrictions imposed by state quarantine orders and for each state should be prepared for inclusion in the circular suggested, by the official in charge of the plant inspection service. Such a circular might appear as a revision of circular No. —of the Bureau of Entomology, providing arrangements for coöperation with the United States Department of Agriculture can be made. In this case, the restrictions upon interstate and international shipments of plants by the National Plant Quarantine Act and by the Quarantine Orders issued by the Federal Horticultural Board might perhaps with advantage be included in the same publication.

It is essential, the writer believes, that such a circular, to serve its greatest usefulness, be revised annually and be issued with regularity on or about October first of each year. The issuance of such a circular would not, however, in itself, fulfill the desired object of placing the information in the hands of those principally concerned. A mailing list for the distribution of the circular should be maintained under the supervision of the secretary of this organization, made up of lists of nurserymen and florists doing an interestate business to be furnished by the officials in charge of the plant inspection matters in the various states. Such a mailing list would, of course, need annual revision.

Need and Means for Better Coördination of Efforts of State Plant Inspection Officials

Practically all of the state horticultural laws require a certificate of inspection from the shipper's home state as a condition for the acceptance of nursery stock importations. Experience in those states where inspections of the shipments are made at destination shows that as a measure of protection this requirement fails utterly to accomplish the desired object. Under present conditions it is even harmful in one respect—it hinders and delays the spread of the system of inspection at destination which has been adopted by only a few states, but which is destined to become general. The additional requirement of some states of fumigation of nursery stock as a condition of entry is, in the writer's opinion and experience, of very little value as far as stock admittedly infested in any degree is concerned.

Arizona, with its insufficient supply of home grown nursery stock

and with its population of more than ordinary cosmopolitan origin, receives nursery stock and other plant supplies from nearly every state in the country. The figures presented in the introduction of this paper for the first season's operation of the inspection law indicate that where the shippers are not fully aware that inspection at destination is practiced, nearly nine shipments out of 100 are actually infested in some degree by injurious insects; moreover these infested shipments are each accompanied by a certificate declaring that the shippers stock has been duly inspected within a year and found free from injurious insects.

The writer has several times been moved to attempt to preserve the dignity of the plant inspection profession by explaining that some insects, although admittedly injurious, are so widely distributed in some sections of the country that further attempts to prevent their spread by means of nursery stock in such sections are of comparatively little value. Let us, however, consider the Eastern peach tree borer. Are there not even in the most generally infested Eastern states, fruit-growing sections, or sections which are yet undeveloped, where this pest does not exist? And is it not the duty of nursery inspectors to give consideration to the protection of such sections.

Dr. O. C. Bartlett, assistant state entomologist of Arizona, formerly deputy inspector in Massachusetts, informs me that in the latter state there are sections which need protection against the common peach tree borer. Doubtless this is true also of practically every state in the East. In the far West, however, the Eastern peach tree borer is very limited in its distribution and in Arizona and neighboring states there is just as much reason to exclude this pest as the San José scale.

Shipments of peaches, plum and apricot trees infested to a greater or less degree by the Eastern peach tree borer have been received in Arizona during the past three years from at least five states located north and east of us. In one case a shipment of about 3,000 peach trees which appeared to be the infested discard of a nursery was received at Phoenix. In this case a certificate supposed to show that the trees had been free from injurious insects when inspected in the nursery, accompanied the shipment of trees which were not only infested, but for the most part virtually killed by insect pests. Trees killed by San José scale could not have been of less value than these girdled peach trees. When notified that the shipment either must be burned or must be reshipped, the nurserymen wired that they expected their "certificate to protect them." Needless to say, it did not. Is it not important that state inspectors, for the sake of their reputations, and honest nurserymen, for the sake of their business, be protected against such an abuse of official inspection certificates?

The writer considers the most important matter confronting this association is the coördination of the work of the state inspection officials throughout the country in order to accomplish the greatest measure of success in preventing the spread of insect pests. Doubtless each member of this Association has ideas upon this subject. The ideas to be presented here are offered as a basis for coördination, which at present is almost entirely lacking, for the accomplishment of the above purpose.

First. We should make this a more effective organization of official horticultural inspectors by securing the enrollment and active interest of the inspection officials in charge in those states not now represented and furthermore we should make this organization a center for active coöperation instead of maintaining it primarily for the purpose of holding annual meetings, however helpful such meetings may be even without further activity for 363 days in the year.

Second. We need a uniform system of nursery and plant certification. Certificates of inspection should mean more than the destination inspections made in some states show them to mean. Assuming that the nursery inspectors in each state make full reports to their chief of all insects injurious or likely to become injurious found in each nursery inspected and assuming that these records are filed, could not a simple system be devised for furnishing the head inspection official in all other states a sworn statement of the actual condition of each nursery as regards insect pests? If the findings show the nursery absolutely free from insect pests, let the certificate be issued in accordance therewith, otherwise I propose that for interstate shipments a certificate be used which will state plainly that the nursery has been found free from pests *with certain exceptions filed with the officials in charge of plant inspections in every state in the country, also that the nurserymen accepting and using the certificate has agreed to use every reasonable precaution against including any infested stock.*

In cases where such a special certificate is issued, the nurserymen should be bound to assume his full share of the responsibility in the matter. For example in the case of the Eastern peach borer, certificates might fairly be issued with the agreement that they are revokable upon the presentation of proof to the chief inspector that such a certificate has been used on a shipment in which more than one susceptible fruit tree in five hundred contained a live borer. Similar arrangements could be made in the case of the woolly apple aphis, perhaps providing for special exterminative treatments in this case. The patrons of the nurserymen concerned could well afford to have added to their bills the slight expense occasioned by such arrangements. If all the states having provisions for nursery inspections

would adopt this uniform system, no honest nurseryman could complain of unfair treatment in the matter.

If such a plan of coöperation as proposed were adopted, much of the clerical work could be economically centralized through this organization. A fixed annual assessment not exceeding $10 for each state would allow a remuneration for the supervisory, and other work of the secretary and pay for all clerical assistance that may be needed.

Is it not both practicable and timely for this organization to consider, endorse and actively promote some plan to standardize the value of certificates of nursery inspection?

WHAT BESIDES INSPECTION?

By H. A. Surface, *Harrisburg, Pa.*

In the official performance of our duties as inspectors, we often feel that more can be done for mankind than mere inspection of property of an owner and notifying him of the absence or presence of pests and means of suppressing them. I do not think there is a worthy member of this association who in his inspection work does not go beyond the mere formalities above mentioned. As officials guarding the welfare of the public, no doubt we all take the new, modern and practical view that "prevention is better than remedy." Note how our health departments and sanitary commissions are turning their attention toward not only the eradication of diseases, but especially their prevention. In fact, all of us who are engaged in the important work of inspection realize that the detection of pests through this service is chiefly for the purpose of preventing their dissemination and, therefore, the work is more preventive than curative. The grower of trees or plants who receives the benefit of this service little realizes what it really means. Without it he would be invaded by pests such as he has not before known, and hence of species that he would not recognize until the damage might be irreparable, or their eradication or suppression accomplished only by extremely expensive means.

We know full well that there are many very serious insects and plant diseases that may yet reach our respective states, and fortunately, for our citizens, have not yet made their appearance within our borders. Can we expect to keep out some of these pests, many of which are more terrible than any we now know, by our own efforts at inspection work, however thorough it may be?

It is always important to know what others are doing in their respective fields, and compare notes in order to adopt the best methods

to our own needs. With the hope of developing discussions that may prove profitable in this exchange of ideas or plans and experiences, we take this subject, and open it for general discussion by stating, first, some of the features of our own work, outside the actual inspection service, to prevent dissemination of pests.

Of course, with the nursery inspection we make a special feature of the San José scale and require all infested stock to be destroyed or removed to another part of the nursery and treated thoroughly with an approved insecticide, like strong lime-sulfur solution, and absolutely cleaned up, before it can be sold or shipped. Also, we follow the regulation method of requiring all nursery stock of kinds liable to infestation by San José scale, grown in an infested nursery, to be fumigated in the prescribed manner, and a certificate of fumigation attached, before it can be sold or transported. We inspect all nurseries during the summer, beginning August 1, and also during the winter, when the deciduous trees are dormant, and pests are to be more easily detected.

All of the above is a regular part of the inspection work. In addition to this more has been found necessary. For example, we have found it necessary to inspect not only the nursery stock, but all the older fruit trees and other trees and shrubs liable to infestation by scale growing in *or near* the nursery. We have found our nurserymen quite anxious to grow clean stock, and to be spared the expense and trouble of destroying infested stock and fumigating that which they sell and ship.

The inspection of surrounding orchards and certain other trees and shrubs has aided greatly in eliminating the original source of the scale, because this inspection, even though not on the nursery property, is followed by compulsory treatment. The infested premises near nurseries are re-inspected, and the inspector makes certain that the scale is cleaned up, before the next season for its spread. Where the owner does not do this according to our directions, we proceed under legal authority to do the work, and the charge becomes a lien upon the property, the same as tax.

In addition to seeing that the premises surrounding the nurseries are kept clean of injurious insects and diseases that would attack the nursery stock or be disseminated thereon, we impress upon the nurseryman the importance of selecting his cions from clean stock.

We know of one instance of a large nursery free from scale, excepting on two varieties of apples. Upon inquiry we found that these were propagated by fruit grafts made from cuttings furnished by a fruit grower of New Jersey, who was anxious to have his own bearing trees used for propagating stock for himself. It is the earnest

opinion of the writer that propagation from bearing trees carries with it more evils than benefits. The cuttings used for this purpose are those that are most sure to carry San José scale and certain other pests to the nursery. In other words, the stock propagated from nursery stock is, as a rule, much cleaner than that from bearing stock. We are willing to go on record further, as having expressed the opinion that cuttings from bearing stock do *not* come into bearing at any younger period than those from nursery stock, contrary to the popular opinion.

Ours must be constantly a campaign of education. We must educate the grower, not only in methods of suppressing pests, but also in methods of avoiding them. To do this we must anticipate what pests may be liable to occur, and instruct the nurserymen and growers who have not had opportunity to make a careful study of this subject. For example, we have had gratifying results by sending to our nurserymen and florists colored picture cards, giving faithful representations of the brown-tail moth and the gipsy moth in their various stages. This is in order to acquaint them with the pests, in order that they can watch for them. In a few cases the growers have immediately declared that *they had such insects on their premises,* but when asked to produce specimens, have been able to show nothing worse than some of the common Noctuids or Cut-worm moths.

It would be best to be on the safe side, however, and be suspicious of any insect that may occur on imported stock, until its real nature is pointed out by an expert. Therefore, we have urged nurserymen and florists to be particularly watchful, and send us specimens of insects in any stage that may be found, in order that we can determine them and give such instruction as may be useful in preventing the spread of the same. It must be said, to the credit or our nurserymen and florists, that they have made good use of the facilities thus offered to them. They have been told that wherever they see a dead leaf held to a twig or to the bark by any means, it is liable to be attached by a web, which means the work of an insect or spider. They are urged to pick off and destroy all such nests with their contents, and wherever these are not well understood, to send specimens at once to the office of the economic zoölogist.

In addition to the above campaign of education and inspection we have tried to educate the final grower or orchardist to recognize the pests on nursery stock and refuse to accept a plant that is seriously infested or infected. Crown gall is one of the serious diseases now causing trouble on stock shipped from other states into Pennsylvania.

In a recent public demonstration a shipment from another state was found entirely infected with this disease. Upon corresponding

with the grower of the stock, he replied that it had been shipped into Pennsylvania by mistake, as it was really packed for shipment to another state. It is certain, however, that it never had subsequent opportunity to get into other hands.

Growers have learned the importance of planting clean, healthy stock, and demand our services quite extensively for the inspection of shipments that they have received both from home nurserymen and those abroad. The inspection service of other states in giving attention to the possible infestation of stock shipped from our own state has been useful in helping to detect infestations, and to make sure that the growers are observing the requirements of our law. It is very advisable to inspect the shipped stock from the home grower, and notify him concerning the findings.

The careful attention that is being given at the present time by the Federal Horticultural Bureau, as well as by the various state inspectors, to imported nursery stock brought into this country by parcels post, as well as by other methods of shipment, is resulting in keeping serious pests out of our country. We hope to see the day when the Federal Horticultural Bureau is supplied with men and funds for making their own inspections, as many of us are working under appropriations that were made to meet the needs of our several states respectively as they exist, without anticipating the heavy demand upon us for federal inspection service, which has recently been made.

Our nurserymen now fully realize their moral sense of duty in preventing the infestation of some otherwise clean orchards, by stock which they may send out, and, fortunately, from this consideration, are guarding against such trouble more carefully than ever before. We feel that the emphasis of the moral obligation in this subject is important, and when we fully realize that in sending infested or infected stock to a man whose orchard may be clean, we are liable to destroy that person's property, as well as ruin our own prospects as nurserymen, we become more careful to avoid such catastrophies.

We hear very little and, indeed, far less than formerly in our state concerning questionable dealing by the tree agent rascal, as was heard a few years ago. We believe that the moral tone given to the nursery business both indirectly and directly through the inspectors' service has had much to do with helping to suppress this old-time fraud.

In many cases we have found demonstrations for the nurserymen quite advisable. It has had a beneficial effect when we have come to their premises to show them how to operate a fumigating box or house, or to show them how to spray thoroughly some of their stock

for certain pests. Our efforts to take up and study their problems, as in our recent investigations of the Bud Mite, published in the *Bi-Monthly Bulletin* of the Division of Zoölogy, can be cited as an example of work for the nurserymen which is appreciated. They have come to regard the inspectors as their friends and helpers instead of oppressors. Their problems are passed on to us for solution, and when they are given practical answers they appreciate the service we thus render to them.

In conclusion, let us say, that besides inspection, we find that no small part of the service to be rendered by the inspector for the benefit of both the nurserymen and the orchardist, is through a campaign of public education in every way possible. By this means the importation of pests to a great extent is avoided, and the dissemination of older pests is reduced to a minimum.

A New Opening for Entomologists: The Agassiz Association, Sound Beach, Conn., is looking for an entomologist, preferably a married man, to lease a building site in Arcadia, erect a small cottage thereupon and devote most of his time to a study of insects. The remuneration offered, as stated by the gifted and enthusiastic president of the association, Edward F. Bigelow, is "the best pay in the world—the joy of doing and the joy of helping." Mr. Bigelow states that he is looking for some one who has retired from the active duties of life and expects to spend the rest of his days in close proximity to the entomological world.

Entomological Meeting in California, 1915

The Entomological Society of America has received an invitation from the Panama-Pacific International Exposition to hold a meeting in some Californian locality in the summer of 1915. This gathering may be at either of the universities or on the exposition grounds. It has received the enthusiastic support of western entomologists. These latter have attended many eastern meetings and this is an excellent chance for us to return the compliment. It may be possible for a number to go out with a party, stopping off at one or more interesting points en route. As chairman of a special committee to consider this matter and report at the next meeting of the association, the undersigned invites suggestions in regard to this meeting and also expressions relative to the support it would probably receive from eastern entomologists. E. P. Felt, State Museum, Albany, N.Y.

Mexican Fruit Fly (*Trypeta ludens*). Quarantine order number 5 has been emended by the Secretary of Agriculture to prohibit the importation of grape fruit and its horticultural varieties from Mexico.

THE CONTROL OF THE PERNICIOUS OR SAN JOSÉ SCALE

(*Aspidiotus perniciosus* Comst.)

By E. O. Essig

An address delivered at the Convention of the Northwest Inspectors' Association, Spokane, Washington, November 15, 1912

The destructiveness of the Pernicious or San José Scale has been so great and its distribution so rapid throughout this country that it has received more real scientific investigation than has been accorded to any other common pest, excepting perhaps the codling moth, and it is doubtful if even this latter should be made an exception. Indeed, so much has been done in every state to devise new and efficient means of control that I wonder why this subject should have been allotted to me for presentation before such a body as this. Perhaps it is because so much has been written and so little is ever presented in a personal way that much of the real practical information is lost. Climatic conditions so change the modes of operation in controlling this pest that we find certain specialized systems which vary with the different localities. In view of these special conditions I shall attempt to include only those lines of procedure which may be used by all. In fact I believe that the only available suggestions which I can give will resolve themselves into recommendations for the proper application of spraying methods.

The control of all insect pests has usually been directed along purely artificial lines, such as the applications of powders and sprays, and the use of certain gases. In many of the states no other methods have been thought of or attempted. But in justice to all parties, we should recognize here at least two important controlling factors—artificial and natural. The former include spraying, fumigation, etc., and the latter, the importation, establishment and distribution of natural enemics.

Artificial Control. Among the methods artificially used in controlling this pest, spraying is recognized as most efficient in proportion to the cost involved. No doubt fumigation would be more thorough and lasting, but the outlay for equipment, chemicals and the tremendous wear upon the tents, makes this method impracticable. We may also safely say that lime-sulphur is the accepted insecticide. Originally salt was added to make it more severe, which proved as destructive to the trees as to the scale, and like all other detrimental ingredients was left out as soon as this fact was definitely established.

Looking squarely at the problem of the control of this scale at the

present time, I believe that success depends entirely upon four factors: (1) the chemicals used; (2) the dilution necessary; (3) the methods of application, and (4) the time of application.

1. *The chemicals used:* As previously stated, lime-sulphur spray is the proper remedy for the Pernicious Scale. All early experimental work with this spray was necessarily made with the home-made products, and it was several years before commercial spray companies began to turn out first-class and dependable insecticides. In the meantime all published investigations and extension work were based upon the home-made solutions. In fact, we must come down to the last few years to find any number of station bulletins or reports recommending the commercial product. Consequently the growers have been slow to accept anything but those first recommended, and it is little wonder that such proves to be the case. Those of you who have made a special study of the preparation of this spray know that it is difficult to always get a like and satisfactory product, and it is not strange then that the preparations made by the average grower are not only unsatisfactory but often worthless. Practically all of the failures in the control of this scale may be traced directly to these worthless sprays, and I feel confident that success begins with the use of a thoroughly reliable commercial product.

Spray manufacturers are becoming keenly alive to the possibilities of efficient sprays and are now employing the best experts and machinery in the manufacture of their products. The results are so much better than those obtained by even the best home-made solutions that they are being gradually supplanted by the commercial sprays. However, in many sections of our own state the home-made product is still used, and I dare say that a few farmers still persist in adding the salt also. In order to reap the benefits of large purchases the growers of a community should unite in buying the preparations by the carload lot. This is becoming common practice in many parts of California with the result that the growers are now enjoying prompter service and lower prices than they could ever hope to get as individuals.

2. *The dilution necessary:* Too often good material is wasted by improper dilution. The prime considerations are always cost and efficiency; neither of which should be sacrificed for the other. We find one grower applying a spray much too strong at a big cost, while his neighbor is doing the opposite. Of course the extent of infestation, the relative openness and the size of the trees must be taken into consideration. Some growers always make their sprays just strong enough to meet the most favorable conditions, while others aim to provide against all unfavorable factors, and this latter class is certainly more

successful in controlling the Pernicious Scale. The directions accompanying the commercial productions usually give the dilution one part of lime-sulphur to thirteen parts of water. The resultant spray is satisfactory and efficient if all conditions are right, but usually they are not. In our work we are inclined to recommend that the dilution be one to nine, while some growers go farther and say that one to six is not too strong. Naturally we find some difference in the commercial products, but it is safe to say that most of the reputable houses aim to make them all about the same strength; and so we find Rex as good as Ortho, these being practically the only commercial sprays now used in California.

3. *The methods of application:* To my mind the right application of a spray is often more important than any other factor. A poorly made product is often efficient if plentifully and thoroughly applied.

Pumps. Always the first consideration is a good pump. The best, of course, is a power machine. Some hand pumps give fairly good results but for the best work the growers, even those owning ten and twenty-acre orchards, are coming to see the efficiency behind the power sprayer. Many are clubbing together and securing jointly such a machine, which is capable of spraying all their orchards thoroughly several times a year.

Pressure. In application, pressure is the greatest consideration. It must be sufficiently and evenly maintained in order to drive either a fine or coarse spray with force enough to drench the most secluded and protected spots. It should not fall below one hundred and fifty pounds to the square inch, while two hundred pounds is much to be desired, and should be insisted upon.

Nozzles. The spray for the particular pest in question should be fairly coarse and driving and applied with some such nozzle as the "Whirlpool," "Jumbo," "Mistry, Jr.," "Friend," etc., using a large-holed disc. The angle nozzle or a straight nozzle on an angle nipple is certainly an improvement over the old straight form, making it possible to easily and quickly reach any portion of the tree from any position. In our work we use two nozzles to a hose, employing a straight "Y" with angle nozzles, or an angle "Y" with straight nozzles.

Thoroughness. One good application is worth many poor ones. It has been found that one thorough spraying accomplishes as much in controlling the codling moth as three poor ones did under older and more careless methods. The same is true of the Pernicious Scale. Every part of the tree should be drenched. The tops are never exempt, even though some of the material gets into your eyes. It seems to be a common practice to omit the upper third of the tree. Last year I

saw results of a test spraying where whitewash was used, and in almost every instance the tops received no treatment. If the application is thorough the dilution can be greater. The one to thirteen dilution is efficient if the work is good, and the one to nine will give no better results if large patches on the trees are left untouched. I believe that it is better to use an excess of a somewhat weakened spray than to use an insufficient amount of a real strong solution.

In order to make the areas sprayed more apparent and to avoid missing portions of the trees, some of our growers add ten pounds of slacked lime to every one hundred gallons of the diluted lime-sulphur spray.

Under proper management one application should serve to keep the trees in good condition for one or two years.

4. *Time of application:* Fall and winter are the proper times to spray for this scale. It must be remembered that the pest is then more or less dormant. In many parts of California the winters are mild and the resistant powers of the scale are not so great as in the colder regions, and it is quite possible that somewhat better results can therefore be obtained. Though I am not at all familiar with work under your conditions, I should think that it would be advisable to begin spraying in the fall, just as soon as most of the leaves have fallen, and before the scale becomes too dormant.

Natural Enemies. The use of natural enemies has been responsible for much good in many of the states, and especially in California. Many badly infested orchards have been mysteriously rid of the scale much to the surprise of the unsuspecting orchardists. The important natural checks—the internal parasite, *Aphelinus fuscipennis* How., and the predaceous two-stabbed lady-bird beetle, *Chilocorus bivulnerus* Muls., both of which are native insects—are responsible for most of this work. The average orchardist is not content to leave the subjection of the scale to these natural foes, and this attitude has been abundantly justified by the many failures of these beneficial insects. However, they are always to be sought as a valuable adjunct to artificial control and in not a few cases they have proven the salvation of an industry.

Conclusion. In conclusion I might state that under normal conditions the control of the Pernicious Scale in California and elsewhere is exceedingly successful. I can remember when the presence of this pest in an orchard meant complete condemnation of the fruit, while today little is thought of such an occurrence. In fact, many of the localities which were badly infested are today comparatively free of the pest; a condition due to a more thorough understanding of the control methods herein presented.

THE IMPERIAL BUREAU OF ENTOMOLOGY

By C. Gordon Hewitt, D. Sc., *Dominion Entomologist, Ottawa, Canada.*

As the question of international effort and coöperation in the matter of controlling and preventing the spread of insects which in various ways affect human activity is occupying the attention not only of entomologists, sanitarians and workers directly occupied in studying these many-sided problems, but also of statesmen and administrators, the formation in connection with the British Imperial service of an Imperial Bureau of Entomology at the beginning of the present year will undoubtedly interest all concerned in these problems by whom the progress and work will be watched.

This organization is not a sudden development, but a gradual outgrowth of efforts along similar lines which began in the spring of 1909. In March of that year a meeting was called by the Secretary of State for the Colonies at the Colonial Office in London, in which the present writer had the honor to take part, to discuss the formation of an Entomological Research Committee for the purpose of furthering entomological research in the British possessions in tropical and sub-tropical Africa. The chief insects which it was considered desirable to study were those associated with the transmission of disease. In 1909 an Entomological Research Committee of the Colonial Office was appointed by Lord Crewe, then Secretary of State for the Colonies; it consisted of the chief experts in entomology and tropical medicine in Great Britain and Ireland, with Lord Cromer as chairman. Its work fell under three divisions, namely, the carrying on of investigations and entomological surveys in tropical Africa, for the purpose of which two traveling entomologists were employed; the determination of entomological material and the publication of the work so accomplished, for which purpose the *Bulletin of Entomological Research*, a quarterly journal, was started. Through the generosity of Mr. Andrew Carnegie the committee was able also to undertake the training of entomologists for service in the Dominions and Colonies.

On account of the valuable service which was being rendered by the committee to the African crown-colonies and protectorates, suggestions were made for the enlargement of the scope of the work of the committee. Accordingly, in June, 1911, advantage was taken of the presence in England of the Prime Ministers of the self-governing Dominions and a conference was called by the Secretary of State for the Colonies to consider the desirability of further extending the work already begun by securing the coöperation and financial support of the self-governing Dominions and Colonies. By this means mutual

assistance could be rendered by the various countries within the British Empire through the medium of a central bureau, which would be engaged in the collection and interchange of information in regard to noxious insects. It was unanimously agreed that the establishment of such a central bureau was desirable, as it was realized that valuable assistance could be given in the way of disseminating information and other services. Accordingly a tentative scheme was submitted to the governments of the various self-governing Dominions and Colonies for their consideration.

After due consideration a further conference was held at the Colonial Office in August, 1912, to which the government entomologists of the self-governing Dominions and Colonies and others similarly interested were invited to discuss and work out a scheme for Imperial coöperation in preventing the spread and furthering the investigation of noxious insects. At this conference the whole subject was thoroughly discussed and a proposal was evolved for the establishment of an Imperial Bureau of Entomology to be financially supported by the various Dominions and Colonies and the British Government.

It was proposed that the functions of the Imperial Bureau of Entomology should be as follows:

1. A general survey of the noxious insects of the world and the collection and coördination of information relating thereto, so that any British country may learn by inquiry what insect pests it is likely to import from other countries and the best methods of preventing their introduction and spread.

2. The authoritative identification of insects of economic importance submitted by the officials of the Departments of Agriculture of Public Health throughout the Empire.

3. The publication of a monthly journal giving concise and useful summaries of all the current literature which has a practical bearing on the investigation and control of noxious insects.

The scheme was accepted by the various self-governing Dominions and Colonies which were invited to coöperate, and the crown-colonies and British Protectorates will also participate in the advantages of the Imperial Bureau of Entomology which has now been established. The former entomological Research Committee has become the honorary committee of management with the eminent administrator, the Earl of Cromer, as president and the scientific secretary of the committee, Mr. Guy A. K. Marshall, has been made director of the Bureau and editor of the journal. The government entomologists of the Dominions are *ex-officio members* of the committee of management.

The publication of the Bureau's journal which is entitled *The Review of Applied Entomology* was commenced in January. It is being pub-

lished in two parts: Series A, Agricultural and Series B, Medical and Veterinary. As the organization and library of the Bureau becomes perfected, the value of this journal to entomological workers cannot be overestimated, when it is remembered that there are no less than 1700 periodicals, scientific, agricultural and medical which may contain articles dealing with entomology, but a small proportion of which widely scattered entomologists have the opportunity of seeing or the time to consult.

An idea of one aspect of the three years work of the original Entomological Research Committee will be gathered from the fact that the collections received from collectors in tropical Africa and other parts of the world during that time amounted to about 190,000 insects, of which no less than 56,000 were actual or potential disease carriers. The value of this function of the Bureau to entomologists situated in portions of the Empire where there are no collections and little literature to aid in identification will be realised by their more fortunate fellow-workers.

It has been stated that the Imperial Bureau of Entomology will serve the needs of the British Empire in a manner similar to that in which the United States Bureau of Entomology serves those of the United States. This statement, however, is not correct. Its primary function will be that of an intelligence Bureau, collecting information for the use of British countries supporting it, and assisting entomologists and other officials in those countries in the identification of their material. By these methods which have been mentioned and by the publication of *The Review of Applied Entomology*, it will furnish a means of assistance and of coördination of effort in the war against noxious insects which will undoubtedly soon make its services invaluable in the further development of the countries, and especially the tropical and sub-tropical countries, of the British Empire. International as the scope of its enquiries are, the work of the Bureau cannot but prove to be one of the most potent factors in enabling us to develop the agricultural and other resources of the Empire, and our fellow-workers in non-British countries can avail themselves, through its journal, of some of the fruits of the Bureau's work.

THE LIFE CYCLE OF LACHNOSTERNA TRISTIS FABR.

By J. J. Davis, *Bureau of Entomology*[1]

Until the present time the life cycle of but one species of Lachnosterna (*L. arcuata*) has been worked out and recorded in literature.[2] This

[1]Published by permission of Chief of Bureau.

[2]Bull. U. S. D. A., Div. Ent. No. 19, n. s., p. 77.

species was studied by Mr. Theodore Pergande from 1893 to 1895 and found to have a life cycle of practically three years, in the latitude of Washington, D. C., remaining in the grub stage parts of three years, the total larval period being slightly over twenty-five months. It has been the general opinion that all Lachnosterna have a three year life cycle in the northern States and we have much data both from artificial breeding experiments and from field observations to prove that this is the case for many species. One species (*Lachnosterna tristis*), however, has been found by us to be an exception to the rule, it having a life cycle of only two years.

Several pairs of *L. tristis*, collected *in copula* on oak at Lafayette, Indiana, May 13 and 17, 1911, were confined in two twelve-inch standard flower pots which had previously been filled with soil, the top sodded and the pots themselves sunk into the ground. The beetles lived on an average of about two weeks, a rather short period in comparison with other species of Lachnosterna. During life the beetles were supplied with fresh oak foliage every few nights and they were out feeding every night, excepting when too cold or stormy, re-entering the soil each morning. The cages were examined October 9, 1911, and it was then observed that the grubs in these cages were as large or larger than the same aged grubs of other species, although the adults of *tristis* are much smaller than adults of these other species. Owing to the shallowness of the pots the grubs could not enter the soil as deeply as under natural conditions, and it was therefore necessary to cover the tops with a light mulch of manure. Even with the mulch the soil in the pots became saturated with moisture and for several months it was frozen solid. Notwithstanding these apparently unfavorable conditions live grubs were found when the soil thawed in the spring. Complete examinations of both cages were made September 23, 1912, a single adult female *tristis* being found in one cage, while one male and one female were found in the second cage, all occurring in the pupal cells and within an inch of the bottom of the pots which were filled with ten and one-half inches of soil. In neither cage were grubs or pupæ found. These beetles would have emerged in the spring of 1913, which gives a period of two years from the time the eggs are laid until the appearance of the adults above ground, the total length of the grub stage being about one year. All other species of Lachnosterna being studied at Lafayette have a life cycle of more than two years, probably all having a three year cycle, although definite data will not be obtainable for these species until this fall.

From our present meagre data on the economy of this species I conclude that it is one of the least economically important species of

Lachnosterna, although further studies may disprove this conclusion. Dr. S. A. Forbes has listed it as one of the eight species of the genus known to be injurious.[1] In our own collections made in following the plow we have encountered the adult *tristis* but once. A single male in its pupal cell was plowed up April 25, 1911, in an upland clay loam field which was surrounded by general timber. This field had been in corn in 1910, clover in 1909, and oats in 1908, showing that the egg had been deposited when the field was in clover.

ITONIDA ANTHICI N. SP. (DIPT.)

By E. P. Felt, *Albany, N.Y.*

The striking clusters of pinkish white, flower-like galls produced by this species on cypress, *Taxodium distichum*, were collected repeatedly by Dr. W. L. McAtee of the Bureau of Biological Survey, Washington, and forwarded to this office from Mud River, Ark., Carlisle, Miss., and Barachias, Ala. The galls are sometimes so numerous as to dominate the dark green cypress foliage and give the appearance of an ordinary flowering plant thickly set with small blossoms. Dr. McAtee informs us that birds feed upon this gall and upon other cypress midge galls. The larvæ winter within the galls, the pupæ making their way partly out of the side of the gall and the adults evidently appearing in early spring, since this peculiar deformity seems to arise from a leaf bud and is probably a greatly hypertrophid leaflet.

Gall. Blossom-like, a variable pinkish and white. Length 3 mm., somewhat bell-shaped, the margin more or less expanded, sometimes irregularly crenulate and generally enclosing a distinct cup-shaped depression. There is an oval cavity, length 1.25 mm., at the base of the gall, inhabited by an orange-red larva.

Larva. Length 2 mm., oval or narrowly oval, orange-red. Head short, moderately broad, the antennæ short, tapering, biarticulate. Breastbone distinct, greatly expanded apically and with two widely separated, minute, triangular teeth. Skin coarsely shagreened, posterior extremity broadly rounded, nearly smooth.

Exuvium. Length 2 mm., whitish transparent. Thoracic horns rather short, stout, antennal cases moderately stout, extending to the base of the abdomen, the wing cases to the fourth abdominal segment and the leg cases to the sixth abdominal segment, each abdominal segment basally with three or four rows of moderately stout, chitinous spines, the posterior portion irregularly dotted with chitinous points.

Male. Length 1.25 mm. Antennæ $\frac{1}{4}$ longer than the body, thickly haired, reddish brown; 14 segments, the fifth having stems, each with a length $\frac{1}{4}$ greater than its diameter. Circumfili moderately long, stout; terminal segment, basal portion of the stem irregular, with a length thrice its diameter, the distal enlargement irregular, produced, with a length more than twice its diameter, obtuse apically. Palpi; first segment quadrate, the second narrowly oval, the third a little longer and more slender than the second, the fourth $\frac{1}{2}$ longer than the third. Mesonotum dark

[1] Bull. Ill. Agric. Exp. Sta., No. 116, p. 449.

brown, the submedian lines fuscous yellowish. Scutellum and postscutellum fuscous yellowish. Abdomen sparsely haired, dark brown. Wings hyaline, costa dark brown. Halteres dark reddish, yellowish basally. Coxæ fuscous yellowish, the legs mostly dark brown, the tarsi nearly fuscous; claws simple, the pulvilli about ½ the length of the claws. Genitalia; basal clasp segment narrowly oval; terminal clasp segment short, stout; dorsal plate short, divided, the lobes cordate; ventral plate longer, broad, triangularly emarginate, the lobes obliquely truncate; style short, stout.

Female. Length 2 mm. Antennæ ¾ the length of the body, sparsely haired, fuscous yellowish; 14 subsessile segments, the fifth having the basal enlargement with a length 2½ times its diameter, the circumfili stout and well elevated; terminal segment produced, tapering, with a length thrice its diameter, obtuse apically. Palpi; first segment irregular, second narrowly oval, the third ¼ longer than the second, more slender, the fourth ¾ longer than the third. Abdomen reddish brown, the short ovipositor yellowish. Halteres fuscous yellowish, fuscous subapically. Coxæ and femora mostly fuscous yellowish, the tibiæ and tarsi a little darker. Ovipositor about half the length of the abdomen, the terminal lobes lanceolate, with a length thrice the width, sparsely setose. Other characters practically as in the male. Type Cecid. a2120.

A NEW GALL ON PERITOMA SERRULATUM

By T. D. A. Cockerell

Galls on Capparidaceous plants appear to be scarce. Houard, in his great work on European galls, cites only two: one, Lepidopterous, on *Capparis œgyptiaca*, the other, Dipterous, on *Capparis spinosa*. The former consists of a globular enlargement of the stem; the latter, due to *Asphondylia capparis* Ruebs., is a deformed and hypertrophied flower-bud. It appears worth while, therefore, to bring forward a quite different gall from Capparidaceæ, consisting of a deformed and enlarged pod, in which Dipterous larvæ live in great numbers.

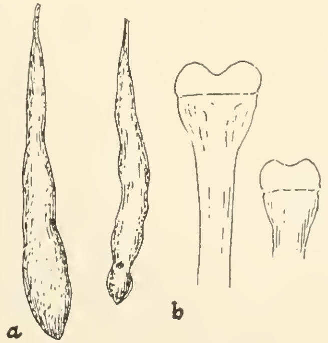

Fig. 2. *Cecidomyia peritomatis; a*, galls; *b*, breastbone of larva (original).

Cecidomyia peritomatis n. sp.

Gall. A more or less claviform, variously enlarged pod of *Cleome serrulata* = *Peritoma serrulatum*. Frequently the pod is deeply constricted subapically. The larvæ live in great quantities within or among the seeds.

Larva. Orange, rather slender, 2.5–2.75 mm. long; antennæ conical, acorn-like; mandibles very robust; breastbone with the head about twice as broad as the stem, obtusely bilobed, the median emargination variable, but never very deep, no lateral projections; pseudopods of posterior extremity like the end of a finger, obtuse; bristles of caudal tubercles very short.

Hab. Santa Fé, New Mexico, by Santa Fé River, Aug. 1912. (*Cockerell*). The breastbone may be compared with that of *Thurauia aquatica* Ruebs. (Wien. Ent. Zeit., xviii, taf. I. f. 1.), but it differs in having the head much less abruptly enlarged, and the lobes much rounder and less elongate, the median emargination consequently much more shallow.

CONFERENCE OF FOREST ENTOMOLOGISTS

At the conference of investigators and specialists of the Branch of Forest Insects of the Bureau of Entomology, U. S. Department of Agriculture, held at Washington, D. C., February 26 to March 1, the following subjects were discussed: methods of conducting investigations in the field and laboratories; methods of disseminating information based on the results of investigations, including popular and technical publications, correspondence, etc.; field demonstrations and instructions in the practical details of controlling and preventing depredations by tree-killing and wood-destroying insects; methods of promoting the science and practice of forest entomology; the services already rendered by the Branch of Forest Insects, the services to be rendered in the future, and the relation of the Branch to other branches of the public service and to private interests.

In the discussion of results so far attained it was shown that information on the habits and life history of the Dendroctonus beetles (a group of the most destructive insect enemies of living timber of North America) has been determined and that the practicability of the methods recommended for their control and the prevention of their ravages has been proven by a large number of successful demonstrations conducted during the past six years in coöperation with private owners, the Forest Service, and the Department of the Interior. It was also shown that the published information on the relation of insects to North American forests covers a wide field, both in the line of general information on the entire subject and specific information on the more important insects and problems. It was estimated that a general application of the information already determined and disseminated would save tens of millions of dollars annually to national and private interests in the prevention of waste of forest resources and manufactured crude and finished forest products. It was also shown that the results of original investigations, as published in the technical series of bulletins of the Bureau, have secured for the Branch of Forest Insects favorable recognition and comment among entomologists of this and other countries. In the discussion of the interest manifested it was stated that twenty years ago there was practically no interest in the subject and the idea of any practical means of controlling the depredations of insects in North American forests was not only foreign to the thoughts of foresters and private owners but any suggestion of such a thing was ridiculed. At present there are probably no forest officials who do not know something about the importance of forest insects and the need of protection from

their ravages, and the private owners of forests and the public are beginning to take an active interest in the subject, especially in sections of the country where any attention is given to forest conservation.

In discussing the services to be rendered in the future it was concluded that the greatest present need is in the line of further systematic and economic investigations of the more important injurious and beneficial species and the orders, families, and genera of insects which are represented by species of economic importance, and that specialization by experts should be a primary feature in the policy of the Branch, as applied to systematic and economic investigations and practical details in application.

Following the discussion of the relations of the Branch of Forest Insects to other branches of the public service and to private interests, it was agreed that it is that of the scientific investigator and technical advisor on insect foes and friends of the forest and on methods of preventing unnecessary waste of forest resources. It was shown that a representative of the Branch rendering assistance to another branch of the public service—federal or state—or to private interests—organized or individual, great or small—does so with the idea of rendering a public service through the results of practical application by the beneficiary. Therefore, no direct assistance should be required of such a representative unless there is assurance from the beneficiary that there will be an equivalent return in results which will further the interests of the nation, the state, or a community of local interests.

The present organization of the Branch of Forest Insects, with Dr. Hopkins Chief of Branch, includes four field stations: Station 1 at Missoula, Montana, for Montana, northern Idaho, Wyoming, Colorado, and South Dakota, with Josef Brunner in charge; Station 5, at Placerville, California, for California, Nevada, Arizona, and New Mexico, with H. E. Burke in charge; Station 6, at Ashland, Oregon, for Oregon, Washington, Utah, and southern Idaho, with W. D. Edmonston in charge; and Station 8 at Falls Church, Virginia, for the eastern states, with S. A. Rohwer in charge. These stations do not represent administrative divisions but are centers for the investigation of local problems and for the conducting of instruction and control projects. In addition to the force of three to five men at each station, there is a staff of specialists at Washington engaged in the systematic investigation of the more important orders of insects and special subjects, as follows: Scolytid beetles—A. D. Hopkins; Forest Hymenoptera—S. A. Rohwer; Forest Lepidoptera—August Busck; Forest Coleoptera (general)—W. S. Fisher; Forest Diptera—C. T. Greene; Forest Isoptera—T. E. Snyder; Cerambycid larvæ—F. C. Craighead; and Buprestid larvæ—H. E. Burke.

Some of the special field investigations now under way are—the investigation of chestnut insects and their relation to the chestnut bark disease, general; insect damage to telegraph and telephone poles, posts, mine props, etc., by T. E. Snyder; relation of lightning and insects to the death of trees, by W. D. Edmonston; damage to fire and insect-killed timber by wood-boring insects, by B. T. Harvey; damage to forest tree seeds by insects, by J. M. Miller; damage to reproduction pine by tip moths and pitch worms, by Josef Brunner; the relation of mistletoe and witches broom on living trees to attack by insects, by H. E. Burke.

Experiments are under way to determine the relative immunity of different untreated and treated woods from damage by termites, by T. E. Snyder, and experiments are planned to determine the smallest percentage of an infestation to be disposed of to insure the control of the depredations by the various species of Dendroctonus beetles.

March 12, 1913.

SOCIETY FOR THE ADVANCEMENT OF FOREST ENTOMOLOGY IN AMERICA

An organization to be known as the Society for the Advancement of Forest Entomology in America was effected at a meeting held at Washington, D. C., on March 1, 1913, with A. D. Hopkins, T. E. Snyder, S. A. Rohwer, F. C. Craighead, C. T. Greene, and W. S. Fisher, of Washington, D. C., H. E. Burke and J. M. Miller of Placerville, California, Josef Brunner of Missoula, Montana, and W. D. Edmonston of Ashland, Oregon, as charter members.

The object of this society is to promote a more general interest in the subject of forest entomology and the protection of forest resources from avoidable waste due to the depredations of insects.

Membership is open to persons who manifest an interest in the subject of insects in their relation to the forest resources and the forest products of North America, providing that they are recommended by a member or a responsible person, and the initiation fee of fifty cents and the annual dues of fifty cents are paid to the secretary-treasurer.

The following officers were elected: president, A. D. Hopkins; vice president, H. E. Burke; recording secretary, T. E. Snyder; corresponding secretary-treasurer, F. C. Craighead.

Annual meetings will be held at which the economic side of forest entomology will be discussed, including the reading of papers on the conservation of forest resources. It is intended to publish Proceedings when the Society becomes established on a sufficiently extensive basis. In the meantime papers and discussions of general interest will be presented for publication to forestry, entomological and timber journals.

Persons interested in this movement should correspond with Mr. F. C. Craighead, corresponding secretary-treasurer, Room 410, Evening Star Building, Washington, D. C.

March 12, 1913.

Correction. In the legend of Plate 2, Volume 6, No. 1, all of the figures stated to be enlarged 6.7 times are enlarged about 3.9 times and the one stated to be enlarged 49 times is enlarged about 35.5 times.

Scientific Notes

Insect Collections, Kansas University. The entomological collections of the University of Kansas form a distinct division of the fire-proof Natural History Museum. These collections are increased from year to year in two ways, first, by a regular, organized entomological survey which adds about 25,000 specimens per year, and second, through systematic exchanges with other collections and well known collectors. Last year the 28th annual expedition was in the field twelve weeks.

There are now 984 types in the collections and 300,000 specimens representing 26,000 species.

At the death of the lamented Dr. Snow in 1908 Professor S. J. Hunter, head of the Department of Entomology succeeded to the curatorship and Mr. F. X. Williams became assistant curator.

The Museum is open to investigators, but types are not loaned. Information, however, is cheerfully given regarding types and when desired drawings are made by the department's artist at a nominal cost. A revised list of types is now being prepared for publication.

Locality Records of the Douglas Fir-Seed Chalcid, (*Megastigmus spermotrophus* Wachtl). In a recently issued review of the literature[1] on chalcids injurious to forest tree seeds, Mr. S. A. Rohwer calls attention to the fact that the Douglas fir-seed chalcid had not yet been recorded as having been reared from the seeds of Douglas fir raised in the United States.

Records in my possession indicate that the infestation of seeds of Douglas fir is probably quite general in Oregon and Washington. Further observations may show the whole region of the Douglas fir to be similarly infested.

I have collected or bred this species from seeds grown in the following localities:

Colville National Forest, Washington.

National Forests, Western Oregon and Washington (seeds mixed).

Tacoma and Olympic National Forest, Washington (seeds of these two localities mixed).

Wenatchee National Forest, (Chiwaukum Ranger District) Washington.

Wenatchee National Forest, (Churnstick Ranger District) Washington.

All localities hitherto examined by me have shown infestation. Up to the time of the present writing I have not examined Douglas fir seed from any other localities than those recorded above.

V. I. Safro, *Oregon Agricultural College, Corvallis, Ore.*

Phytonomus meles Fabr. This obscurely colored clover weevil, kindly determined by Mr. E. G. Titus, appears to be a recent introduction, since there is no record of its capture prior to June, 1907, at which time it was taken in New York by Mr. R. E. Dow. It was reared in our office in July, 1908, from clover collected in the vicinity of Albany, and the latter part of May, 1912, the weevils were observed very abundant on red clover at New Baltimore, N. Y. The insects at that time were feeding upon the foliage and causing some injury. A number of pairs were observed in copulo. Titus has observed the deposition of eggs on and in the stems and leaf petioles of clover and alfalfa, and on the blossoms of clover. Five to seven eggs were deposited in the stems, while elsewhere they were placed singly. European

[1]Bur. Ent. Tech. Ser. 28, Pt. VI.

authors have recorded this insect as feeding upon several species of Medicago as well as *Trifolium incarnatum* in addition to red clover.

The known distribution as given by Titus (Ann. Ent. Soc. Amer. 4:440–41) shows that this European species has established itself pretty well over New England and also in the Hudson valley. It would seem from our observations that the customary early cutting of clover for hay will ordinarily prevent serious injury though this would not apply to sections where clover seed is generally produced. We have, in this species, a recent introduction which will bear watching and may, like its forerunner and ally, the much larger, punctured clover leaf weevil, *Hypera punctata* Fabr., cause considerable apprehension if not serious injury.

E. P. Felt.

White ants, historical. It may be of some interest to Boston readers to know that on November 15, 1883, twenty-nine years ago, the *Boston Evening Transcript* devoted two and one-half columns to an invasion of the State House by White Ants. Quoting from the article: "Now that election is over and the people have had time to shift their thoughts from the governor and his campaign, it would be improper to further delay speaking of the new danger which threatens the Capitol of the Commonwealth. The enemy which has effected a lodgement under the gilded dome is small but mighty and his name is legion. He works in the dark and unceasingly. He would undermine our halls of legislation and offices of state. He is the Guy Fawkes whose plotting is perennial, the blowing up of whose mine is ever imminent. He is at this moment perhaps making ready for the grand overthrow and demolition of the crowning glory of Beacon Hill. His point of attack is at the foundations, and his name is *Termes flavipes* or in vulgar parlance, the white ant."

The room in which they first appeared was in the center of the building and it was feared that if their progress was not checked, the wooden girders might be attacked and result in bringing down the whole structure. If this did not happen, there would at least be some danger to life and limb if the stair supports became infested. In 1882 a document stored in what was then known as the "Dungeon" in the basement of the State House was found to have been eaten in a rather odd manner and Mr. Pierce, then Secretary of State, sent a sample to Doctor Hagen, who at once pronounced it as the work of "white ants." The papers were taken out and sprinkled with insect powder and the contents of the room put in bags and subjected to fumigation with sulphur.

According to the article, Doctor Hagen advised a thorough examination by a competent and conscientious engineer. The shelves of the room where they were found were to be taken out together with the plastering and the woodwork beneath thoroughly inspected. Particular pains were to be taken to find out if the insects had gone up or down stairs. Inasmuch as their presence was suspected in other parts of the building, the expenditure of $1,000 was advised for an examination which might save ten thousand dollars some years later. Doctor Hagen also thought that a standing item for this work should be included in the annual appropriation bill so that the public would be constantly reminded of the danger threatening their capitol and its contents. The nest of the ants was supposed to be in the Common or Public Garden or in an old tree in the vicinity.

Doctor Hagen then called attention to a wooden bridge at Porters Station, which was injured by "white ants" and to an ashpit in the works of Alvan Clark & Sons (makers of astronomical instruments) at Cambridgeport, the posts of which, becoming honeycombed with ant chambers, collapsed some time in 1876. The bridge at Porters Station was supposed to have been selected by the ants on account of its

moist condition, caused by the steam from locomotives which were stopped under it forty times or more every day. The article then quotes at some length from Doctor Hagen's paper "The Probable Danger of White Ants" which appeared during 1876 in the *American Naturalist*.

H. B. Weiss.

Bleeding trees. The exudation of sap and an accompanying discoloration of the bark below, the latter caused in part probably by precipitates, is more or less familiar to all conversant with trees and is particularly likely to occur on sugar maples and the American elm. The causes of this trouble, owing largely to the fact that the flow originates at a somewhat inaccessible point, are not well understood. There may be several factors involved, and observations made by competent parties at different times show that these exudations may be inhabited by Dipterous maggots. Dr. E. B. Southwick mentions this (*Insect Life* 7: 136) and attributes it to the sap fly, *Mycetobia pallipes*, though there is a statement to the effect that Dr. Hopkins then thought it might be due to a species of Sciara.

Last fall we observed numerous larvæ superficially resembling Sciara, inhabiting a somewhat profuse flow of sap originating from a crevice in the trunk of a sugar maple at Kinderhook, N. Y. The point below the injury was brown, corrugated and seemed to be covered with precipitates from the sap. Examination of the cavity showed the larvæ to be present in the deepest portion of the crevice where they apparently kept the tissues in a constant state of irritation. Sap issuing from a similar wound on a horsechestnut trunk was inhabited by probably identical larvæ.

A study of the larva obtained from the above mentioned sugar maple shows that it can not be a species of Sciara and is probably referable to the genus Ceratopogon, particularly as Joseph Mik describes as *C. hippocastani*, adults reared from very similar larvæ which he found in sap from a bleeding horsechestnut. A study of the specimens we collected showed the presence of jaws admirably adapted to gnawing or eroding the more tender cortical tissues. In view of the fact that many of these bleeding wounds are known to be inhabited by Dipterous maggots, some of which at least resemble Sciara larvæ, it would not be surprising if this Ceratopogon or its allies at least, prevented the normal healing of wounds and, under certain circumstances, may be the prime cause of the trouble. The larva is described below in order to facilitate the recognition of this insect.

Larva. Length 5.5 mm., diameter .5 mm., a slender, white larva with a brown or dark head and superficially resembling Sciara. The head has a diameter posteriorly equal to that of the body and tapers anteriorly to an irregularly truncate apex bearing the mouth-parts, the length being nearly equal to its greatest diameter. The mandibles are decurved, apparently biarticulate, the distal sclerite narrowly triangular and apically with a stout, curved tooth, the ventral margin being variably armed with smaller, stout spines. The basal sclerite is subquadrate, with a length about four times its width and articulates with the exo-skeleton of the head and also with a sub-median, slender internal rod extending to the posterior fourth of the head and there articulated with a similar slender member of a hyoid-like structure extending in turn to the posterior margin of the head. The mouth laterally and ventrally appears to be guarded or assisted in its functions by two pair of rounded lobes, each margined with a thick tuft of rather long, recurved setæ. There are other mouth structures which we will not attempt to describe. Antennæ biarticulate, the basal segment with a length $\frac{3}{4}$ its diameter, the apical segment appearing as a very broad, button-like appendage. The exo-skeleton of the head bears a few small setae, there being apparently four such submedian setæ, one pair near the anterior third, the other near the posterior fourth. There are twelve body segments, the divisions not being well marked. The anterior spiracles terminate in eight slightly thickened, radiating, nearly fused processes on the anterior body segment, and the posterior spiracles are submedian, nearly apposed, the distal portion of the tracheæ distinctly

chitinized. The skin of the body is smooth and a small lateral seta occurs near the middle of each of the anterior two segments. These body setæ, if uniformly present, are extremely fine. There is a fringe of about thirty hairs surrounding the posterior extremity and evidently of service in keeping the larva at the surface when breathing. These hairs are rather stout, adhere apically and form combinations which could easily be mistaken for fleshy lobes. a2364.

E. P. Felt.

Gipsy Moth Conference. On February 22d a conference was held at the office of State Forester F. W. Rane, 6 Beacon St., Boston, at which were present representative entomologists and foresters from the different New England States and New York. Dr. L. O. Howard, Chief of the Bureau of Entomology, and his assistants in the Gipsy Moth work, and Mr. G. E. Clement and Mr. S. W. Dana of the U. S. Forest Service also attended. There were present Mr. E. S. Brigham, Commissioner of Agriculture of Vermont, J. A. Roberts, Commissioner of Agriculture of Maine, Major E. E. Philbrook, in charge of Moth Work in Maine, State Forester Viles of Maine, Prof. W. C. O'Kane, State Entomologist of New Hampshire, Mr. C. H. Hadley, Assistant Entomologist of New Hampshire, Prof. J. H. Foster of the New Hampshire State College, Mr. P. W. Ayers, Secretary of the Society for the Protection of New Hampshire Forests, of New Hampshire, Prof. A. E. Stene, State Entomologist of Rhode Island, Prof. M. R. Blackburn, New York State College of Forestry, Syracuse, N. Y., Mr. George G. Atwood, State Horticultural Inspector, Albany, N. Y., Mr. W. S. Regan, Assistant Nursery Inspector of Massachusetts, Mr. Allen Chamberlain of Boston, Messrs. Bailey, Cook, Gould, and State Fire Warden A. W. Hutchins of the State Forester's office, Mr. H. A. Reynolds, Sec'y, Massachusetts Forestry Association, Dr. W. M. Wheeler of Bussey Institution, Messrs. Rogers, Worthley, and Burgess of the U. S. Bureau of Entomology.

The purpose of the meeting was to discuss the gipsy moth work with particular reference to its bearing on the forest problem. As a result of recent experiments and observations it has been determined that the gipsy moth does not feed as readily on some kinds of foliage as on others, and that there is also a variation in the amount of feeding on certain trees which is done by the small and by the large caterpillars. As a result of this work it is now deemed practicable, in certain types of woodland, to eliminate the favored food plants and in this way the remaining trees are not injured and the territory can be cared for with very little expense. This opens a practical method of handling some of the woodland areas in the infested territory and it is desired to consider this matter from all sides and to secure the interest and coöperation both of the entomologists and foresters in the various states concerned. A report was given of the experiments which have been carried on to secure information on different phases of this work and a statement made of the experiments which it is proposed to conduct during the coming season. The U. S. Forest Service is now working in coöperation with the Bureau of Entomology on the sylvicultural aspects of the gipsy moth problems and Mr. G. E. Clement, one of the trained foresters of that Service, has been detailed to look after that part of the coöperative work. The meeting was of much interest to all the officials concerned, and resulted in bringing up for discussion several features of the work which heretofore had not been taken up in a broad way. It was the desire of all to work in harmony and with as close coöperation as possible, so that the greatest amount of work could be accomplished and unnecessary duplication avoided.

Those present at the meeting were the guests of Prof. Rane at luncheon at the City Club, and it was the unanimous opinion of those present that the conference was of much value, not only to those who attended, but to all the States represented.

A. F. Burgess.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The coöperation of those presenting papers at the recent meeting has made it possible to include most of the Proceedings in the first two numbers. The early publication of this matter is very desirable and no more costly than distributing the papers through three or even four issues. It can hardly be expected that subsequent numbers will be equally bulky, owing to our limited resources.

The passing of another of our older members and an associate of Riley in the earlier years, is recorded in this issue. Though restricted by physical limitations and unable to attend our gatherings, Miss Murtfeldt was known by reputation at least, to most of our members. She was deeply interested in the Association and did her part in contributing valuable papers to the published Proceedings. The past decade has witnessed great changes in our organization. Many of the leaders of a few years ago have been gathered home, while others have been compelled to limit their activities or else have turned to other fields. The young man with a speciality is largely in evidence and our meetings depend for success mostly upon the co-operation of groups of specialists rather than upon discussions by general economic entomologists.

The birth of an association for the advancement of Forest Entomology brings to attention another phase of economic entomology. It will be recalled that provision was made by the American Association of Economic Entomologists at the Cleveland meeting for an apiary and inspectors section, each to be presided over by a vice-president named by the section. There must be coöperation among students along special lines if rapid and substantial progress is made. The method is not so important as the attainment of the ideal. No one should object to a sincere effort toward efficiency, and we take this opportunity of extending good wishes to the child. At the same time we would call attention to the parent organization and express the hope that its influence for good in general entomology and even along special lines may not be hampered by the undue multiplication of associations having closely circumscribed activities.

Obituary

MARY ESTHER MURTFELDT

Mary Esther Murtfeldt was the eldest daughter of the late E. W. Murtfeldt and Esther Murtfeldt. She was born in New York and there as a child she suffered the serious illness which left a slight paralysis so that in all her after life she was restricted in her walking, otherwise she was robust and her physical infirmity seemed only to intensify her mental powers. With her family she moved to Rockford, Ill., where she obtained such education at Rockford College as books could give. In 1869, the family settled in St. Louis and in 1871 removed to Kirkwood, Mo., a suburb about thirty miles west of St. Louis which offered special facilities for her father's business as an agricultural writer and publisher.

Coming into contact with Dr. C. V. Riley furnished a new inspiration to Miss Murtfeldt's entomological studies and placed at her disposal an entomological library of considerable size. Only those of us who prosecuted entomological studies at that time know how much we were all hampered by lack of entomological literature. Of the students who were active at or near St. Louis at this time, Prof. C. V. Riley, Otto Lugger, Miss Murtfeldt, Mr. Theo Pergande, Mr. Schuster and Mr. Monell, all acquired as years went on a certain amount of entomological eminence and this was largely due to the accessibility of Professor Riley's library and collections.

Miss Murtfeldt died February 23, 1913, at the age of about 65 years, heart disease ending her career after a short illness. Many honors crowned her successful studies. She was elected a fellow of the American Association for the advancement of science, an honorary member of the St. Louis Academy of Science and a member of the Wednesday Club of St. Louis.

Cornell considered itself fortunate in owning one of Miss Murtfeldt's collections of moths and offered her a degree for meritorious work in natural science.

At the time of her decease she was associate editor of *Farm Progress*, a biweekly journal issued by the St. Louis Republic, the principle Democratic daily of St. Louis. She also published under the auspices of the State Horticultural Society an introduction to elementary entomology, intended as an introduction to the more formal treatises of Packard and Comstock

Her first publication was in the *Rural New Yorker* 1873 entitled "Women and Science" followed shortly by a paper on the value of natural science for the Education of Women in 1874 before the Women's

Mary E. Murtfeldt.

Congress in Boston. After that Miss Murtfeld's publications were mostly on the Tortricidæ in the standard technical journals.

Miss Murtfeldt is survived by three sisters, Misses Louise, Augusta and Josephine and by two brothers, George of Minneapolis and William of Rockford, Ill.

Reviews

Injurious and Beneficial Insects of California, by E. O. Essig. The Monthly Bulletin of State [Cal.] Comm. Hortic., Vol. 2, Numbs. 1 & 2, pp. I–XXI, 1–351. 1913.

The above departs widely from what we usually meet in serials and is in reality a comprehensive discussion of Californian injurious and beneficial insects, the various forms being treated under class and ordinal headings. This work will be particularly welcome to entomologists, since it gives a summary account of the more important injurious and beneficial forms occurring upon the west coast. The usefulness of the volume to the practical fruit grower is greatly increased by the host index of injurious insects, a detailed list arranged alphabetically under the common names of the various plants upon which the insects occur. Naturally, some groups receive relatively more attention than others, this being particularly noteworthy in the case of plantlice, some 44 pages being devoted to the discussion of a number of species, a few of which are probably not very injurious. The scale insects is the banner group, numerous species being discussed and admirably illustrated on 54 pages. The pre-eminence of these pests is doubtless to be accounted for by peculiar climatic and horticultural conditions. Passing to the higher groups we find the ladybeetles or Coccinellidæ given 26 pages, while the major portion of the account of Hymenopterous insects is devoted to parasites. This relative preponderance is to be expected in a region which has been profoundly influenced by the effective work of ladybeetles upon the cottony cushion scale and the potential importance of at least one of the Hymenoptera, namely, the fig wasp, in addition to the good work performed by the numerous small parasites. A discussion of the codling moth parasite which figured so largely in the public prints a few years ago, is limited to a little over a page and gives no hint as to the actual value of this introduction.

A number of eastern insects are noticed in this work, among them being the two species of canker worms, banding being the remedial measure apparently preferred by the writer. The reviewer has favored the application of poisons for these insects, because this treatment is effective in controlling the canker worms and also in checking other leaf feeders very likely to occur upon the trees. We notice an old friend of the east, the forest tent caterpillar, *Malacosoma disstria* under the somewhat anomalous popular name of western apple tree tent caterpillar. In this instance, at least, the official list of common names for insects appears to have been ignored.

There is a chapter on sprays and poisons. The tabulation for the dilution of kerosene emulsion to secure various percentages will undoubtedly prove of much aid to horticulturists and be of service to some entomologists, since occasional errors in respect to this have crept into print. Several types of spray apparatus are figured, including a dust sprayer. There is a detailed discussion of fumigation with several dosage tables. The work is concluded with a compilation of the California horticultural laws and quarantine orders. This bulletin is printed upon excellent paper and illustrated by over 300 figures, most of them excellent and a number being original.

Report of a Trip to India and the Orient in Search of the Natural Enemies of the Citrus White Fly, by R. S. Woglum. U. S. Dep't. Agric., Bur. Ent., Bul. 120, pp. 1–58. 1913.

This is an exceedingly interesting account of a trip in search of the parasites and predaceous enemies of the citrus white fly. The author visited India, Burma, Java, southern China and the Philippine Islands. He found the parasites in India and gives in detail the methods adopted. Vigorous plants were newly infested with the host insect and placed where parasites and natural enemies would have ready access. At the proper time these were shipped in charge of the investigator, and both the parasites and predaceous enemies arrived safely in this country. Unfortunately, conditions in Florida were such that none survived. We fully agree with the author that two men should be sent on such an undertaking and provision made for at least two and, in some instances, we would prefer a series of shipments, since it is easy to see that the material obtained in the first, second or even third might succumb in transit or even some weeks after arrival.

The writer, in addition to the account relating to the finding of natural enemies, gives observations upon the occurrence and habits of *Aleyrodes citri* in India, comparing them with conditions obtaining in Florida. A series of appendices contain notes on Citrus fruits in India, insect pests of Citrus trees seen in various foreign countries, observations on Coccidæ and their natural enemies in Spain, Italy, Sicily and India, and a brief reference to the work undertaken incidentally in fumigating Citrus trees in Spain.

This bulletin is a contribution to knowledge along the broader lines of economic entomology and is an illustration of the cosmopolitan character of the work. We need, in this country, everything that can be obtained in the way of promising parasites or other natural enemies and at the same time we stand ready to demonstrate the efficacy of American measures in controlling insects by artificial means. The former is a logical though rarely entirely efficient method, while the latter is essential in correcting more or less temporary fluctuations in the numbers of injurious insects. It is to be hoped that the Federal government will continue work of this character and at the same time maintain, as has obtained in the past, a conservative attitude as to the benefits, immediate or potential, likely to result.

Red Spiders and Mites of Citrus Trees, by H. J. Quayle, Cal. Agric. Exp't Sta. Bul. 234, pp. 483–530. 1912.

The author places red spiders and mites next to scale insects as the most important enemies of citrus trees in California. The more injurious of these forms is the citrus red spider (*Tetranychus mytilaspidis*) which is noticed in detail, the life history being given and various stages described. The six-spotted mite (*T. sexmaculatus*) and the silver or rust mite (*Eriophyes oleivorus*) are both fully discussed. The familiar clover mite (*Bryobia pratensis*) of the east is better known in California as the almond mite, since it is more injurious to this than to any other fruit tree. The author states that the red spiders and mites live and breed only on the trees. Each female may produce about 30 eggs and there may be from 12 to 15 generations annually, the pests usually being most abundant during May and June. The chapter on natural enemies is particularly full and especially valuable because the biology of a number of forms are given for the first time and there is an attempt to estimate the value of these species as natural checks. The author advises the application of dry sulfur and hydrated lime or the commercial lime-sulfur spray for the control of these pests. The bulletin is printed on excellent paper and most of the illustrations come out very well.

Current Notes

Conducted by the Associate Editor

The death of Mr. L. E. Ricksecker at San Diego, Cal., January 30, 1913, is announced in *Entomological News.*

Mr. A. G. Hammar, assistant in deciduous fruit insect investigations of the Bureau of Entomology, has been sent to San José, Cal.

The Smithsonian African Expedition, under the leadership of Col. Theodore Roosevelt, collected about 3,500 specimens of insects in East Africa.

Mr. Henry L. Viereck has resigned from the Bureau of Entomology at Washington. His address is now 669 Drexel Building, Philadelphia, Pa.

Mr. P. H. Timberlake, formerly of Whittier, Cal., has been transferred to Utah. His present address is 510 Vermont Building, Salt Lake City.

Prof. E. B. Poulton has been chosen as one of three to represent Oxford University at the International Congress of Zoölogy to be held this year at Monaco.

Mr. Quincy S. Lowry of the Massachusetts Agricultural College, Amherst, Mass., has been appointed assistant in entomology, at the Agricultural Experiment Station, New Haven, Conn.

Mr. Harry B. Kirk, assistant in entomology at the Agricultural Experiment Station, New Haven, Conn., resigned March 4, to accept a position in Forest Insect Investigations in the Bureau of Entomology, Washington, D. C.

Mr. Andrew Rutherford of Scotland, has recently been apppinted government entomologist of Ceylon. His address will be, Royal Botanic Gardens, Peradeniya, Ceylon.

Mr. C. T. Brues expects to spend several months late in the spring in Central and South America, investigating disease-carrying insects under the auspices of the newly established School of Tropical Medicine at Harvard University.

Rev. Abbe V. A. Huard, conservator of the Provincial Museum of Quebec, and editor of *Le Naturaliste Canadien* has been appointed entomologist of the Province of Quebec.

According to the *Canadian Entomologist,* Mr. Frederick Knab of the Bureau of Entomology has been appointed honorary custodian of the diptera in the United States National Museum at Washington to succeed the late Mr. D. W. Coquillett.

Mr. Ernest E. Green, government entomologist of Ceylon, has resigned and returned to England. Personal mail should be addressed, Mote Hall, Bearsted, Kent, England, until further notice.

Mr. F. A. Merrick, a well known collector of nocturnal lepidoptera, died at his home New Brighton, Pa., December 16, 1912. He disposed of his collection last year to Dr. William Barnes.

Professor S. W. Williston, University of Chicago, has been appointed delegate at large of the American Zoölogical Society, to attend the Ninth International Congress of Zoölogy.

Prof. R. W. Harned is secretary-treasurer of the Mississippi Nurserymen's Association, and Professor G. M. Bentley holds a similar office in the Tennessee Nurserymen's Association.

Mr. J. E. Buck, M. Sc., has been appointed assistant entomologist in the Alabama Experiment Station succeeding Mr. W. F. Turner recently resigned.

Prof. F. W. Gamble, F. R. S., has been appointed director of a new research department in Agricultural Zoölogy at the University of Birmingham.

Col. W. C. Gorgas, has been granted permission by the United States Senate to enter the service of the Republic of Ecuador, for the purpose of cleaning up the port of Guayaquil.

An excellent article "Sanitation of the Isthmus" of Panama by Joseph Bucklin Bishop, secretary of the Isthmian Canal Commission was published in *Scribner's Magazine* for February, page 234.

According to *Science*, "Prof. Johnathan Hyatt, known for his contributions on insect anatomy, formerly president of the American Microscopical Society, died at his home in New Rochelle, on December 20, aged eighty-six years."

The nursery inspectors of the New England States were invited to attend the meeting of the New England Nurserymen's Association at Worcester, Mass., February 25, and to join in a discussion of the questions of inspection and quarantine. Dr. H. T. Fernald gave a practical and helpful address.

C. W. Hooker, Ph. D., entomologist of the Porto Rico Agricultural Experiment Station and Plant Inspector of the Port of Mayaguez, died February 12. Dr. Hooker was a graduate of the Massachusetts Agricultural College, class of 1906, and received his doctor's degree from the same institution in 1909. He was thirty years of age and his death followed an attack of appendicitis.

Mr. W. F. Turner who has for four and one-half years served as assistant entomologist at the Alabama Experiment Station, resigned January 15, to accept an appointment under the Bureau of Entomology, Washington, D. C. Mr. Turner is now engaged in insecticide testing work and is located at Vienna, Va.

Prof. Charles H. T. Townsend, government entomologist of Peru, has also been designated director of entomological stations, a central station having been established at Lima. The station at Piura will be maintained as a branch, and devoted to agricultural entomology, and a station of medical entomology has been established at Chosica. Mr. E. W. Rust has been transferred from Piura to Lima, and Mr. J. G. Caterino has entered the service. The government contract with Professor Townsend has been extended until December 31, 1913, and several graduates of the school of agriculture will be trained to take up the work.

Mr. C. T. Murphy, for the past five years in charge of the experimental work of Guanica Centrale, Porto Rico, died suddenly of heart failure at his home at hacienda Santa Rita, Guanica, on January 15, 1913. Guanica Centrale is one of the largest sugar estates on the island and in the various plantations of the company Mr. Murphy has carried on extensive experiments to determine the most practical method of controling the various sugar-cane pests, and the best varieties and fertilizers for the various soils and conditions. His wide knowledge of sugar-cane culture made his results of interest to all the sugar-cane growers of the island. Mr. Murphy received his training under Mr. J. R. Bovell, Barbados, British West Indies. Aside from his practical work in the control of insect pests of sugar cane, Mr. Murphy took a keen interest in entomology and while he was not so situated that he could work up a collection of his own, he never lost the opportunity to assist the professional workers of the island in every possible way.

Mailed April 22, 1913.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD, Wooster, Ohio.

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Will pay 60 cents for No. 2, Volume I, and 30 cents each for No 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
MELROSE HIGHLANDS, MASS.

FOR SALE—Bulletins 1 to 56 and 67 to 74 and circulars 1 to 67 of the Bureau of Entomology, all bound. Also bulletins 47 to 66 and from 75 to date and circular 68 to date unbound.

E. MEAD WILCOX, Lincoln, Nebraska.

WANTED—To buy, sell and exchange insects for demonstration and class work in economic entomology and bulletins and reports on all subjects from U. S. Department of Agriculture and Agricultural Experiment Stations, etc.

R. W. BRAUCHER, Kent, Ohio.

WANTED—Specimens of Calosoma beetles from all parts of the world. Write listing species that can be furnished.

A. F. BURGESS, Melrose Highlands, Mass.

ENTOMOLOGISTS' EMPLOYMENT BUREAU

Conducted by the American Association of Economic Entomologists.

This Bureau will register Entomologists wishing to secure positions. Station Entomologists and institutions desiring to secure assistants are invited to correspond with the undersigned. Enrollment in the Bureau, $2.00.

F. L. WASHBURN,
Experiment Station, St. Anthony Park, Minn.

JOURNAL

OF

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OFFICIAL ORGAN
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MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

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PRELIMINARY REPORT ON THE PARASITES OF COCCUS HESPERIDUM IN CALIFORNIA[1]

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In the early days of citrus fruit culture in California the soft scale (*Coccus hesperidum* Linn.) is said to have been one of the worst of the scale pests, and to have vied with the black scale (*Saissetia oleæ* Bern.) in destructiveness and difficulty of control. At the present time it is little feared by intelligent growers, and in fact plays a rather insignificant rôle in the citrus orchards of southern California. Its present harmlessness is due apparently to its inability to withstand the combined effect of fumigation and the recurrent attack of parasites.

Outside of the fumigation districts the soft scale may be frequently found on cultivated and native shrubbery, yet rarely in large colonies, most often existing in a scattered condition and apparently always under these circumstances being heavily parasitized. As the soft scale, like most Coccidæ, is essentially gregarious in habits, we are led to believe that, whenever it is found scattered by ones or twos over the foliage of its host plant, this condition is due to, and characteristic of, heavy parasitism.

Inasmuch as fumigation appears to be quite as fatal to the parasite as to the host, it is not surprising on the other hand, that the soft scale, when it does break out in a citrus orchard, should increase in an alarming manner for a time and form large clustered colonies on the woody shoots. Such outbreaks do occasionally appear and are

[1] Published by permission of Dr. L. O. Howard, Chief, Bureau of Entomology.

almost invariably confined to the fumigation districts. This condition, we are again led to believe, is brought about or encouraged by the temporary absence of parasites.

Such colonies of the soft scale are more often seen, perhaps, in young orchards on newly broken ground, or even in older orchards where ants are especially numerous. What was probably the worst infestation of the soft scale, that came to notice in the course of two years' study, was located at Riverside, Cal., in the heart of a small tract overrun by the Argentine ant (*Iridomyrmex humilis* Mayr). There is not the least doubt that this and other species of ants eagerly attend the soft scale for the sake of the honey-dew it copiously secretes, and there is reason to believe that they unconsciously or even perhaps militantly protect their provider from the attack of parasites. So far as we are aware, however, this conclusion has never been verified by observation.

The parasites of the soft scale observed in California during the past two years are five in number, and being arranged in order of their probable effectiveness stand as follows: *Aphycus* sp. near *flavus* Howard, *Microterys flavus* (Howard), *Coccophagus lecanii* (Fitch), *Coccophagus lunulatus* Howard, and *Aphycus* n. sp. near *coquilletti* Howard.

The *Microterys*, and sometimes *Aphycus* also, is attacked by no less than eight hyperparasites listed as follows: *Coccophagus lecanii* (Fitch), *Pachyneuron* sp., *Eusemion longipenne* (Ashmead), *Eusemion* n. sp., *Perissopterus javensis* Howard, *Tomocera californica* Howard, *Cheiloneurus* n. sp., and *Cerchysius* sp. The relationship of still another parasite, a new species of *Anicetus*, has not been determined, but it is apparently hyperparasitic.

Aphycus sp. near *flavus* (Howard)

This *Aphycus* is a common and well-distributed parasite of the soft scale in California, and also occasionally attacks small immature specimens of the black scale (*Saissetia oleæ* Bern.).[2] It has been given first place in order of effectiveness because of its more general distribution and its habit of destroying its host in the early stages before any damage has been done or any offspring produced. As a parasite of *Coccus hesperidum* it is partial to the young scales from 1 to 1.5 mm. long, but will attack successfully much larger hosts as long as they are still immature. Old scales that attain a certain degree of convexity are free from further molestation. The smaller hosts are able to support only one parasite, but in the larger ones as many as six or even

[2] The original host record of *A. flavus* given by Howard is undoubtedly incorrect. The peculiar and specialized larval habits preclude the possibility of its being a parasite of *Lepidosaphes beckii* (Newm.) or any other Diaspine scale.

more may mature. This *Aphycus* is able to pass through many generations a year, as it develops from egg to adult in about eighteen days at summer temperature. In many respects its life history is similar to that of *Microterys flavus*, which will be treated more fully.

The other new species of *Aphycus* is extremely rare and has been found only at Carpenteria, near Santa Barbara, and at Avalon, Catalina Island.

Microterys flavus (Howard)

Microterys flavus (formerly placed in the old genus *Encyrtus*) is the largest and the most interesting of all the parasites of the soft scale found in California. It is likewise effective to no small degree and would have been given first place in the above list were it not for two considerations: first, it does not seem to be able to survive in any abundance wherever fumigation is extensively practised; and, secondly, it is a parasite of gravid or even mature scales, which in many instances leave a few offspring to two or three hundred before succumbing.

This species is found throughout central and southern California, but it is much less abundant in Los Angeles County than it is near San Diego and Santa Barbara, or throughout the central part of the state. Although originally described from California it was perhaps introduced with its host many years ago through commerce. It has been reported also from Ceylon, Ontario and several Eastern States. Other recorded hosts in America are *Lecanium corni* Bouché and *Pulvinaria vitis* (Linn.), but it seems to attack only the soft scale as a rule in California.

This parasite is attacked by all of the hyperparasites that were enumerated above, but its abundance is hardly modified by them as a rule, and only one case has been found where it was apparently not able to hold its own. In cases of superparasitism where there is a struggle for the possession of the host between *Microterys* and some other parasite such as *Aphycus*, the former is generally worsted, probably on account of its specialized larval habits. When the struggle is between *Microterys* and *Coccophagus lunulatus*, the most frequent and probably the invariable outcome is that both succumb. In observed instances the *Microterys* has been starved by lack of sufficient food, as it does not attack the *Coccophagus* larva or pupa, and the latter succumbs because of the premature death of the host. *Coccophagus lecanii* is generally a hyperparasite when it comes into conflict with *Microterys*, but one instance has been observed where it was superparasitic. In this case the *Microterys* larva was overcome while still small, and the *Coccophagus* developed as a primary parasite.

The *Microterys* female is a pretty, little Encyrtine chalcid of deep

brownish yellow color and banded wings. The females may be kept alive for fifty or sixty days by feeding them with glucose and water if not allowed to oviposit. If supplied with suitable hosts for oviposition the life of the female is considerably shortened. A female that was kept constantly provided with hosts died apparently of exhaustion after thirty-two days, although it had a constant and copious supply of acceptable food in the honey-dew excreted by the scales. This female deposited 212 eggs during the thirty-two days, and after its death eleven more perfect or nearly mature eggs were found in the oviduct and lower part of the ovarian tubules. Other females that were perhaps less skillfully handled deposited in about the same number of days 91, 98, 99, 103, 116 and 125 eggs, respectively.

This species of *Microterys* like all other Encyrtines that we have observed will reproduce freely by parthenogenesis, and is always arrhenotokous under such circumstances; in other words, unfertilized eggs always produce males, and fertilized eggs females. The female in ovipositing is deliberate and circumspect and has the same general habits of other chalcidoids. The process of ovipositing generally takes about $1\frac{1}{4}$ to 2 minutes, the exact time being more or less dependent upon the resistance met in penetrating the derm of the host. Notes were once taken on a female which oviposited seven times in succession in a single host, all within fifteen minutes. The average time taken for the penetration of the host's derm in this case was fifty-one seconds, the actual periods varying between forty and seventy-five seconds. The full period of oviposition in these instances varied from one minute and twenty-five seconds to two minutes and twenty seconds, with an average of one minute and forty-four seconds.

The female even when confined in a small vial shows considerable judgment in the choice of hosts. The most suitable hosts, or at least those generally chosen first, are newly gravid females which have recently become convex or plump. Such hosts after death have a clear, translucent derm which permits the later stages of the parasite to be studied at leisure. Even these scales frequently produce a few offspring before death ensues, but still older ones are sometimes chosen that produce a large number of young. On the other hand, immature scales as small as 1.5 mm. long may be attacked if larger hosts are not to be found. In the small scales rarely more than one egg is deposited, but in larger ones according to their size, two or three even up to six or seven eggs may be normally placed.

Although it is true that the minimum and maximum amount of food that will support one *Microterys* larva allows for considerable latitude, yet the females seem to have a well-developed instinct for judging the number of eggs that may be safely placed in one host without

superparasitism resulting. In other words, superparasitism is comparatively rare, even when the females reproduce under the artificial conditions of confinement. If too many eggs are deposited in one host, one or several of the larvæ may be killed and devoured by the rest. This disposal of the supernumerary larvæ most frequently takes place while they are still in the second stage, if a study of the larval remains may be relied upon. If, on the other hand, too few eggs are deposited in a given host, the development of the parasites may be retarded. One host has come under observation that illustrated especially well this retardation. It was a large, fully matured scale with substance enough to have supported at least three or four *Microterys* larvæ, but for some reason only two eggs had been deposited therein. The larvæ on reaching their maximum size had failed to consume completely the tissues of the host, and before casting their meconium preparatory to pupation they were obliged to wait until the unconsumed tissues had dried up at least to some measure. The development for this reason was retarded about two days.

The ovarian egg of *Microterys* is a peculiar object with two bodies, one more than twice as large as the other connected together by an extraordinarily long, slender stalk. The larger body is the egg proper, within which the embryo later develops, whereas the stalk and smaller body are specialized structures made use of by the larva even nearly to the end of the larval period. After deposition of the egg in the body of the scale the smaller body is left projecting into the outside air through the derm or integument. It has now contracted into a slender white stalk continuous internally with the still slenderer egg-stalk proper. The egg-body by these means is deeply suspended among the tissues of the host. Externally, moreover, each egg is made evident by the white, projecting stalk which is easily visible under a good hand lens. A study of the location of the stalks in many parasitized scales shows that the female oviposits with few exceptions in the mid-dorsal region of the host.

The egg at summer temperature hatches in about seventy hours after deposition. The newly hatched larva does not drop as might be expected from the egg-shell which is split down on one side at eclosion, but remains anchored therein by its anal end. It even thus maintains without the least doubt an intimate and vital connection with the egg-stalk, and the latter might properly be called a living part of the organism. After each of the two larval molts the exuviæ are pushed back but remain attached to the egg-shell, forming thereby a blackish colored funnel within which the larva still remains anchored. As in the first stage of the larva, an intimate relation is kept up with the egg-stalk until the tissues of the host are nearly consumed and the larva

is practically full grown. A study of the deserted funnels in issued hosts reveals the fact that each one of the two component molt-skins has a delicate, slender tube which penetrates the egg-stalk one within the other.

The egg-stalk as here described is strictly homologous and similar to a larval structure of *Schedius kuvanæ* Howard, an Encrytine egg-parasite of the gipsy moth from Japan. The function of this structure has been described as respiratory, as it is thought that the larva thereby obtains its supply of air from the outside world.

The larva molts for the first time about one day after hatching, and again about two days later. It is full grown in about five days or a little over, and on the sixth day after hatching begins to cast its meconium. After still another day it pupates, in all about ten days from the deposition of the egg.

The pupa of *Microterys* shows marked sexual dimorphism not only in the color that is finally assumed, but also in external structure. The fully colored male pupa is black, and the antennal sheaths are bent around the sides of the head in a way suggestive of the handles of an ancient or Grecian amphora. The female pupa is dark brownish yellow in color, and the antennal sheaths are far less conspicuous, being situated more beneath the head. The pupal period lasts about seven days, but the imago does not become active until a few hours to a day later. The entire developmental period from egg to the issuance of the imago is therefore about eighteen days at summer temperature.

Coccophagus lecanii (Fitch)

Coccophagus lecanii is a scale parasite of generalized habits and wide distribution. It is common almost everywhere in California, and is a frequent parasite of *Coccus hesperidum*, but when associated with *Microterys* or *Aphycus* it is not rarely hyperparasitic. As a primary parasite it chooses small, immature scales without exception, and brings about some pathological change or condition in the host, whereby the hypodermal tissue of the mid-dorsal region becomes more or less black-pigmented. In the case of other hosts, such as *Saissetia oleæ* (Bern.), *Lecanium corni* Bouché and *Physokermes insignicola* (Craw) the blackening of the derm may not be so apparent. Before pupating the solitary larva consumes the entire tissues of the host.

As a secondary parasite this species of *Coccophagus* undergoes a radical change in its larval habits, and becomes an external feeder. The female places its eggs upon either the full grown larva or pupa of the primary parasite, which in only three or four days' time after the egg hatches is entirely consumed or reduced to a shriveled mass

of integument. The *Coccophagus* larva then proceeds to cast its meconium and pupates within the body of the scale, quite after the manner it has when primary.

Coccophagus lecanii like many of the Aphelininæ is normally parthenogenetic in reproduction and regularly thelyotokous, producing females generation after generation without the intervention of the male. A curious phenomenon occurs when this species becomes hyperparasitic, as the offspring has been found to belong to the male sex in all cases so far observed. This change in the sex of the offspring takes place not only under artificial conditions in experiments, but also in the case of hosts parasitized under normal field conditions. The exact factor in this sex determination has not been discovered. It apparently does not inhere in the usually somewhat smaller amount of food, for in some instances the resulting male is fully as large as the normal-sized female.

Coccophagus lunulatus Howard

This species of *Coccophagus* has more specialized habits than the preceding species and is always a primary parasite. It is, moreover, not as common although well distributed in California. It attacks also immature scales of *Lecanium corni* Bouché and *Saissetia oleæ* (Bern.). The original record of its host relationship which states that it was reared from *Chrysomphalus aurantii* (Mask.) is undoubtedly incorrect, as its peculiar life-history practically precludes the possibilty of its being a parasite of any Diaspine scale.* As a parasite of *Coccus hesperidum* it is partial to scales that are about half-grown or larger, but it very rarely if ever attacks those that have become mature. As many as two or three larvæ may successfully develop in the larger hosts.

Unlike *Coccophagus lecanii* this species never blackens the hypodermal tissue of the host although the black-colored pupa lying just beneath the translucent derm, may temporarily cause a blackened appearance. *C. lunulatus* also differs markedly from *lecanii* in always avoiding the vital organs of the host, and in pupating *in situ* before the host has been entirely consumed and killed. The pupæ, in fact, are always found in the still living host, which often survives until after the issuance of the adult. This remarkable habit of the parasite is made possible through the fact that it pupates within the last larval exuvia, which becomes filled with air and acts as a protecting shroud. The meconial discharge, moreover, is not voided at random among

* See Howard, L. O., Insect Life, vol. 6, p. 232, 1894, and Quayle, H. J., Bul. 222, Cal. Agr. Exp. Station, p. 136, 1911.

the tissues of the host, but is wadded up into one or several masses, which may be found during the whole life of the pupa closely appressed to the tip of the abdomen.

Although the host is frequently still living and filled with moist or even watery tissues when the *Coccophagus* is ready to issue, yet the latter easily escapes, and is ready to fly away almost the moment it emerges through the exit-hole. This fact is accomplished the more readily inasmuch as the imprisoned pupa lies always closely pressed to the dorsal derm of the host, with the soft tissues pushed to one side, and since the newly transformed imago is always completely enshrouded in the larval exuvia until it gnaws its way out into the open air. These larval and pupal habits of *lunulatus* are evidently adaptive specializations to prevent the occurrence of desiccation, since the pupæ most frequently die if the host is removed from the twig and allowed to dry up.

Coccophagus lunulatus was described from California, and is not yet known to occur elsewhere. Its specialized habits for living in a semi-arid climate point to California as its native home.

The Hyperparasites of the Soft Scale

Of the hyperparasites mentioned above, we have already spoken of one, *Coccophagus lecanii*, which is usually and essentially a primary parasite. This is true also of *Tomocera californica*, ordinarily a parasite of the black scale, and once only reared as a secondary of *Microterys flavus*. This unique record must be considered more as an indication of the versatility of this species than of anything else. *Perissopterus javensis* has been reared as a parasite of *Microterys flavus* and *Coccophagus lecanii*. It may be therefore a tertiary parasite at times and one individual has been recently reared which was actually of this class, having attacked a *Coccophagus* that in turn had destroyed the larva of *Microterys*. It is probably never a primary parasite in connection with the soft scale, and its value as a parasite of the other recorded hosts is open to doubt. This *Perissopterus* was described by Dr. Howard from Java, and its occurrence in California is noteworthy. As it has been found only at Sacramento, near the State Insectary, it has been presumably introduced. The *Pachyneuron* sp. was reared only on one occasion and is not at all common in connection with the soft scale. Its larva like that of *Perissopterus* is an external feeder.

The remaining hyperparasites are all Encyrtines of the tribe Mirini, and all are obligatory in this role of parasitism. They are in connection with the soft scale internal parasites of *Microterys* or sometimes *Aphycus*, other members of the same subfamily and tribe. In this group of hyperparasites *par excellence* fall the two species of *Eusemion*,

one undescribed, the other *E. longipenne*, *Cheiloneurus* sp. and *Cerchysius* sp. The undescribed species of *Anicetus* is most probably a fifth species of this group, and has been found only at Sacramento.

Cerchysius sp.

Of these species the *Cerchysius* is by far the most common, although in another connection as a parasite of *Scutellista cyanea* and *Tomocera californica* underneath the black scale (*Saissetia oleæ* Bern.). Although it is nowhere abundant, it is rather frequently found under the black scale near Santa Barbara and San Diego. In Los Angeles County it has been rarely found in the last two years. Its presence is at once made known by the characteristic puparium-like shell, which it transforms out of the larval skin of its host, toward the end of its own larval life. As a parasite of *Microterys flavus* on the soft scale it is extremely rare, and has been found only twice, once at San Diego, and once at Santa Barbara. In confinement, however, it reproduces freely on the larvæ of *Microterys*. It is the only one of the Encyrtine parasites of the soft scale that so far has been found to present a distinct tendency toward hibernation.

The undescribed *Eusemion* and the *Cheiloneurus* are both rare and are native species that presumably more or less by chance attack *Microterys flavus* occasionally. Other species of *Cheiloneurus* of which there are many are probably similar in habits, although recorded as primary parasites of various Coccid genera, such as *Lecanium*, *Kermes* and *Pseudococcus*. One or two undescribed species have been reared from Coccinellid larvæ in which connection they may be hyperparasitic on *Homalotylus*. The life history of the present species is nearly identical with that of *Eusemion longipenne*, which will be treated in some detail. The habits of the other *Eusemion* have not been yet fully studied.

Eusemion longipenne (Ashmead)

This species was described by Ashmead from Florida, and his single specimen was reared from *Lecanium* on oak. In California the species has been found at Santa Barbara and the neighboring town of Carpenteria, and has been reared in small numbers from collected material as a parasite of *Microterys flavus*. In captivity, however, it reproduces with facility also on *Aphycus flavus*.

The female is a most industrious worker and spends hour after hour in puncturing the scales and in depositing her eggs. She is apparently unable to determine by means of any tactile or other sense residing in her antennæ, whether a scale contains a primary larva or not, for if supplied with unparasitized material she spends many hours

in examining the scales at first with her antennæ and finally with the ovipositor used as a probe. The latter is therefore not merely an instrument for depositing eggs but is also used in the preliminary process of ascertaining the presence and position of the primary larva within the body of the host. If no larva is present the female withdraws the ovipositor presumably without depositing any eggs, or at least if eggs are placed in the body of an unparasitized scale they fail to develop. If, on the other hand, the female detects in the course of the probing movements of the ovipositor the larva of *Microterys* or *Aphycus* she forthwith places an egg within its body. She also oviposits in full grown larvæ and fresh pupæ after the host scale has been reduced to a mere shell of integument. The primary larva moreover is never under any circumstances killed by the *Eusemion,* until it has completed its own growth and has voided the meconial discharge.

The egg of *Eusemion longipenne* belongs to an entirely distinct type from that of *Microterys* or *Aphycus* and is deposited free within the body of the primary larva or pupa. It is decidedly minute and has only a short pedicel, which is functionless after maturation and finally shrivels away. The egg grows or increases in size with the development of the embryo, so that the newly hatched larva is many times the size of the freshly deposited egg.

The larva is rather distinctive in the three larval stages so that the latter may be readily distinguished. The first stage is characterized by a rather conspicuous tail-appendage, but the head is not developed as in the big-mandibled, tailed larvæ of certain Braconidæ. The tail-appendage persists in the secondary stage although it is much shorter, and the third stage is destitute of any such specialized structure. The larvæ, of course, live free within the body of the host, and their exact position may vary, as they have been found while still small either in the head or the abdomen of the pupa. Two or three may develop for a time within one host, but only one survives. On completing its growth the larva entirely consumes the host except the integument and finally makes its escape from the filmy remains. It then proceeds to cast its meconium and complete its transformations within the body cavity of the scale. The entire development from the egg to the issuance of the adult takes place in seventeen or eighteen days at summer temperature. The adult female has been kept alive in captivity for twenty-eight days when allowed to oviposit and as long as seventy-nine days when not supplied with hosts.

Source of the Parasites of the Soft Scale in California

The source of the soft-scale parasites is of some interest in connection with the long-continued efforts of the State Commission of Horti-

culture in introducing promising parasites and predaceous enemies of scale insects into California. The little that has been said already under the treatment of the individual species indicates that the parasites of the soft scale are either native species of California, or have been introduced accidentally through commerce. The two species of *Aphycus* so far as known are native of the United States, although inasmuch as the species near *flavus* confines its attack mainly to the soft scale it may have been brought with its host into California. The same may be said of *Microterys flavus*, and unless these two parasites have changed their host relationship to a marked degree since the introduction of the soft scale, the probability of their accidental introduction is great. The two species of *Coccophagus* are probably native of California, and *lecanii* is known from many other parts of America.

Leaving out of account those species which are essentially primary in habits, viz.: *Coccophagus lecanii* and *Tomocera californica*, all the hyperparasites except *Perissopterus javensis* are undoubtedly native species and will presumably be found attacking the parasites of native Coccids when these have been studied thoroughly.

Predaceous Enemies of the Soft Scale

This account of the natural control of the soft scale would not be complete without some mention of its predatory enemies. Considering that the soft scale is such a defenceless creature, we should naturally expect that its predaceous enemies would abound. This, however, does not seem to be the case and in fact only one predator has been noticed actually feeding on the scales. This is the common *Rhizobius ventralis* Er. introduced into California many years ago. It is abundant in southern California, being often found feeding on the black scale, but it is rarely associated with *Coccus hesperidum*.

PRELIMINARY REPORT ON THE PICUDO OF COTTON IN PERU

By Charles H. T. Townsend, *Lima, Peru*

Origin, Discovery and Occurrence

The Peruvian cotton square-weevil, *Anthonomus vestitus*, now commonly known in Peru as the *picudo del hielo*, is evidently a native of South America and originally invaded the semi-arid Peruvian coast region, probably centuries ago, from the humid tropical districts bordering the Gulf of Guayaquil. It was originally described by Boheman from the Island of Puná in the Gulf of Guayaquil, and has recently

been carefully redescribed by Mr. W. Dwight Pierce, of the Cotton Boll-weevil Laboratory in Texas.

This weevil was rediscovered by the writer, September 21, 1910, at Cumbibira in the Piura valley, a little below Catacaos, where it was found to be a pest of cotton, breeding and feeding in the buds of the squares. The same year it was found infesting cotton throughout the main districts of the Piura and Chira valleys, and it was later found to be entirely confined to the cotton plant. The above was the first recovery of the species after Boheman's description of it, yet it had doubtless been breeding continuously in the cotton district of the Peruvian coast region ever since and for many years prior to Boheman's publication. The results of its work were conspicuous in the cotton fields during all these years and received the name of "hielo," yet the presence of the weevil itself as the definite cause of these results remained unknown until 1910. The term "hielo" was originally applied to the yellowed and withered squares and newly-set bolls, but has since been incorrectly extended to include dropping and defective ripening or premature to retraded opening and decay of the large bolls, due probably both to Dysdercus attacks and to an undue degree of soil-moisture during the ripening season. It is thus applied quite indiscriminately in Peru at present, but it may be stated here that practically all "hielo" of squares and newly-set bolls is the result of the work of *A. vestitus*, either in feeding or in oviposition and breeding.

In 1911 the presence of the weevil in cotton squares in the Guayaquil district of Ecuador was demonstrated, and it was also found to occur far to the south, in the Chancay valley a little north of Lima. During 1912 it was found abundant in April in the Casma valley, which is just north of the Chancay districts; in some number in July at Lima; in a very few specimens in July above Chosica, the locality being in the Rimac valley at about 3,000 feet; and in numbers in June at Tambo de Mora, which is just north of Pisco. It is thus quite evident that this weevil exists as a cotton plague throughout the Ecuadorian and Peruvian coast regions.

Response to Climatic Conditions

Probably the most highly instructive region in the world for the study of cotton weevil bionomics is comprised in this known range of *A. vestitus*. The cotton districts of the coast and foothill region from Guayaquil southward to Pisco and Ica present every variety of climate above the frost-point temperature that is possible of attainment where the cotton plant may be supported in bearing condition. For example, the localities Guayaquil, Piura, Lima, Chosica,

Ica and the foothill valleys represent six very distinct and conspicuously contrasted sets of climatic conditions.

Guayaquil is hot-humid throughout the year, with heavy tropical rains.

Piura is hot-arid from December to May, and cool-subhumid during nights and mornings from June to November; practically without rain, at most with irregular slight sprinkles or showers during the warm season which very exceptionally become heavy rains known only at long intervals.

Lima is hot-subhumid to dilute subarid from December to May, and cool-humid with continuous cloud-blanket and almost daily drizzling mist from June to November; practically never with heavy rains, and very exceptionally with slight sprinkles or showers in the warm season.

Chosica is hot-arid with a very low relative humidity from December to May, and bracing cool-arid from June to November; with continual clear sky practically throughout the year.

Ica is hot-arid from December to May, hot-arid during days and cool-subhumid during nights from June to November; without rain, drizzle or mist, but with some cloudy weather in the afternoons during August to October, aside from which the sky is practically clear during the day throughout the year.

All of the above localities are practically but little above sea level, except Chosica which is 2,800 feet. Just a little farther back in the foothills from Chosica and a little higher up lies a region of valleys which are hot-humid from December to May with considerable rain fall, and cool-arid from June to November with clear sky. The climate of the Ica cotton districts is markedly distinct in character from that of all the immediately surrounding districts, due to wide rainless deserts on both sides of the valley, and approaches that of Piura to such an extent that it is only in the Piura and Ica districts that the native tree-cotton or pais variety can be profitably grown. Ica is just nine degrees farther from the equator than Piura and its nights during the cool season are colder, but on the other hand it has less atmospheric humidity during the cool season than Piura.

The weevil is quite certainly active at practically all times of the year in the humid tropical Guayaquil district. It is known to be practically inactive in the Piura region from December to May, which season is truly arid in this region; and very active from June to November, which months show considerable atmospheric humidity. It was known to be very active in March and April in the Casma region in 1912, during a period of considerable atmospheric humidity. It seems quite certain that it is more active during the warm season in

the central coast region, as from Casma to Lima, than during the rest of the year. It was found at Lima to be only moderately active during July. The season from June to November in the Lima region seems cool enough to interfere to a considerable extent with the weevil's activity, at least to the extent of retarding its development considerably. The Lima temperature ranged during July, 1912, from 55° to 68° Fahrenheit, or 13° to 20° Centigrade; while the humidity hovered around the saturation-point most of the time. The rest of the year does not show sufficient aridity to check the activity of the weevil, while the much higher temperature accelerates its development. The warm season of 1912 was unusually humid in the Casma to Lima region, and it is therefore certain that the weevil was more than ordinarily active there at that time; but it is equally certain that it remains active through the hot season to a considerable extent in the central coast region, while in Piura the excessive aridity cuts short its activity.

Chosica is colder at night and warmer during the day in the cool season than Lima. Its temperature ranged during July, 1912, from 45° to 79° Fahrenheit, or 7° to 26° Centigrade; the relative humidity is very low throughout the year. The weevil was found at the very lowest ebb of activity in July, 1912, just above Chosica, only one adult being found in a green square during two hours' search. It is quite certain that it is somewhat more active in the Chosica region during the warm season, but not enough so to cause any material damage. The Chosica climate can not be termed even subhumid at any time of the year, though the relative humidity is slightly higher during the warm season.

The weevil is not yet investigated in the Ica districts, but it is practically certain that it exists there to a somewhat greater extent than at Chosica. It was found abundant and active at Tambo de Mora during May and June, 1912. Temperature at Ica during July, 1912, ranged from 45° to 73° Fahrenheit, or 7° to 23° Centigrade. Its nights during the cool season are thus about the same as those at Chosica, while its days are not so warm. It is arid like Chosica for most of the year, except for considerable relative humidity at night only from June or July to November and some slight cloudiness in the day from August to October. This climate must allow the weevil at least two or three months of activity during the year, but it is probably not so highly active here at the best as during the more pronounced subhumid season in Piura. It is worthy of note that, while the weevil is probably the least active in the Chosica and Ica districts, its maximum of activity in these two districts comes at opposite seasons of the year.

In the San Bartolomé to Matucana districts and others just a little farther back into the foothill region from Chosica and higher up, where the warm season changes to humid while the cool season remains arid, the weevil should be decidedly active from December to May, much more so than at Chosica. Matucana is 7,800 feet altitude, yet its temperature during July, 1912, ranged from 45° to 77° Fahrenheit, or 7° to 25° Centigrade. Its nights are therefore practically the same during the cool season as those at Chosica and Ica, while its days at the same season are slightly warmer than the Ica days and slightly cooler than the Chosica days. So far as the climate goes, certain varieties of cotton would undoubtedly produce well as high up as Matucana, but the weevil would quite certainly be able to maintain itself there and would cause much damage to the crop during the warm growing season.

The above data are sufficient to show the remarkably complex character of the more or less arid coast to foothill climate of Peru, which exhibits numerous gradations of aridity and humidity with opposites often contrasted in juxtaposition. A comparative study of the weevil in these various districts will not only throw full light on the bionomics of cotton weevils in general, but will indicate those districts of the Peruvian coast and foothills where cotton may be cultivated with little or no danger of injury by the weevil.

It is important to point out here the factors which give rise to this climate with its variations. The tradewinds sweeping southwest across the Atlantic gather moisture to saturation in their course, which they gradually yield up as they cross the Brazils and ascend the eastern slope of the Andes. Their last particle of moisture is extracted by the snow and ice crests of the Andes, so that when they pass high over the Peruvian coast region they are perfectly dry. The wide Humboldt ocean current from the Antarctic region hugs the whole coast of Peru and its waters are about seven degrees Centigrade colder than the superincumbent layers of the air. The winds which blow from the south over this cold ocean current have their moisture largely extracted by it before they can cross it while their temperature is at the same time much lowered; thus when they strike the much warmer littoral precipitation is impossible, and it is only when they arrive far enough inland and high enough up to encounter soil temperatures equal to or colder than their own that precipitation of their residue of moisture takes place. The distance inland and the altitude for this precipitation vary with the season of the year. These data furnish a basis for more or less exact calculations indicating the climatic variations peculiar to the different districts at different seasons.

Parasites and Predaceous Enemies

In Piura the following hymenopterous parasites are at work on the weevil during the subhumid season:

Triaspis vestiticida—Well distributed and most abundant of all the enemies of the weevil in the Chira and Piura valleys. This species alone kills over 12 per cent of the weevil in Piura, while all the other parasites together only raise the percentage of weevils killed by parasites to short of 17 per cent.

Microbracon vestiticida—More or less distributed in both valleys, and more numerous than any of the remaining parasites but less than one sixth as numerous as the preceding.

Cerambycobius townsendi—Sparingly distributed in both valleys, and only a little more than half as numerous as the preceding species.

Cerambycobius peruvianus—Very rare. Chira valley.

Catolaccus townsendi—Small numbers in both valleys, but principally in the Piura valley.

Eurytoma piuræ—Still smaller numbers than preceding, in both valleys.

The determinations of the above are by Mr. J. C. Crawford (Chalcidoidea) and Mr. H. L. Viereck (Ichneumonoidea).

The following species of hymenopterous parasites have been reared from lots of weevil-infested squares and bolls from the Piura region, and while the probabilities are that they are parasites of the weevil they are not yet positively known as such:

Microbracon sp.—One from each valley.

Cantharoctonus stramineus—New genus and species. Two from lower Chira valley.

Daictimorpha peruviana—New genus and species. Three from the Piura valley at Catacaos.

Encytinæ—An undescribed new genus and species. One from each valley.

Rogas sp.—Three from three separated points in the Piura valley, and two from the Chira.

Pseudapanteles sp.—One from lower Piura valley

Chelonella townsendi—Four from the middle Chira valley.

Determinations are by Messrs. Crawford and Viereck.

From several lots totaling less than 400 infested squares collected in the upper and lower Casma valley, April 1 to 7, 1912, there were secured 455 weevils and not a single parasite. This seems very strange. It certainly indicates that parasites of the weevil were practically inactive, if present at all, in the Casma valley during the first week of April, 1912, while the weevil was highly active. As parasites of the weevil are known from the Lima region, it seems hardly possible

that they can be absent from the Casma valley. It appears more likely that the abnormally humid hot season of 1912 in the central coast region was unfavorable to the parasites of the weevil, but not so to the weevil itself.

On July 9, 1912, 143 yellowed and withered squares were collected at Santa Beatriz, near Lima, from which were secured thirty-nine weevils, nine known parasites of the weevil and five doubtful parasites. The fourteen parasites secured from this lot are as follows:—

Catolaccus sp. probably *C. townsendi*—Two females and five males agreeing with this species in color.

Microbracon sp. near *M. vestiticida*—Two males. Differs from this species in the disposition of black, but may be only a variety.

Braconid sp.—One. Doubtfully parasitic on the weevil.

Braconid sp.—Three males; and one female that seems to belong with them, but differs in coloration. Rather small for parasites of the weevil.

In Texas a small black stinging ant, *Solenopsis geminata*, is well known as a very effective enemy of the boll-weevil, often killing 25 or 30 per cent of the early stages in the fallen squares. This species exists in the western foothills of the Andes, and it is almost certain that it would destroy the early stages of the picudo in Peru as effectively as it does those of the boll-weevil in Texas. A closely allied ant, doubtfully determined as *Solenopsis pylades* by Dr. Wheeler, occurs commonly in the Piura cotton-fields where it is known as *hormiga picador*, but it has not as yet been observed to prey upon the weevil. Colonies of *S. geminata* should be transferred from the Andean foothills to the cotton districts of the coast region, and established there.

In Guatemala an ant known as the kelép, *Ectatomma tuberculatum*, is known as a very effective enemy of the adult boll-weevils, which it seeks and attacks in the green squares while they are engaged in feeding and ovipositing. This species exists in the eastern foothills of the Andes, being known to range from Guatemala south through Costa Rica and the Andean montanya to the valley of the Rio Beni in Bolivia. Colonies of it should be transferred from the montanya to the cotton districts of the coast region, and there established if possible. Its introduction was attempted in Texas, but the conditions there were unfavorable to it. The conditions in the Peruvian coast region would probably prove much more favorable to the kelép than those of Texas.

Cultural Control Measures

The carrying out of a carefully planned series of experiments is urgently needed to demonstrate the details of cultural control measures

against the weevil that will be adapted to the very different sets of conditions existing in the various cotton districts of the coast region. The variety of conditions that obtain in the different districts has already been dwelt upon, and it is evident that specific recommendations must be made for each set of conditions. The following general lines of cultural control work should be tried out under varying conditions, with different varieties of the cotton plant:—

(1) Plant the cotton far enough apart so that the sun may strike the ground between the plants during the more humid season of the year, at this time keeping the fields clean of weeds and grass and pruning out enough of the branches in large plants to prevent shading of the ground. This will allow the hot sun to dry up the fallen squares containing the early stages of the weevil, thus killing the latter.

(2) Irrigate during the dry season and allow as much shading of the ground by the plants and weeds as possible during that season, in order to increase the humidity in the fields. While the result will be a certain amount of increased activity on the part of the weevil, what is more important the parasites and enemies of the weevil will remain largely active through the dry season and in that case will probably gain on the weevil from year to year until they dominate it. The parasites appear to develop in a somewhat shorter time than does the weevil, and it is probable that they do not persist through the dry season as readily nor in as large proportion as does the weevil. It seems thus indicated that they largely lose in the dry season the ground gained during the humid season, which would explain their present inability to catch up with the weevil in point of numbers. This applies to districts like Piura Department which have a pronounced dry season. Rearing experiments covering the Piura and Chira cotton districts have shown that the parasites and weevils to develop in the squares and newly-set bolls during July and August at the rate of one parasite to about five weevils. As these parasites are all native species and have undoubtedly been at work on the weevil in Piura Department for very many years, perhaps centuries, it is clear that they will never catch up with the weevil there under present conditions. It is very probable, however, that they may be aided to the point of greatly increasing their efficiency.

(3) Cut the cotton plants back every year, or replant every year, the replanting or cutting back to be done as nearly as possible at such season as to bring the bulk of the production of green squares on the plants at the dryest season of the year. This may perhaps be done in certain districts with some varieties of cotton. In those districts having a very dry season it would prevent damage by the weevil by allowing the buds and flowers to form while the weevil is

quiescent or inactive. The crop would have to ripen and be gathered in the more humid season, and this fact would make the measure impracticable in many districts. In any event this measure can only be combined with the first above described, and not with the second.

With regard to the fostering of the parasites, as outlined in the second measure above, it should be noted that the only data at present available indicate the possibility of the proportion of parasites falling off later in the season from that above given. From lots collected September 18 to October 11, 1912, by my assistant, Mr. E. W. Rust, at one point, San Jacinto, in the lower Chira valley, there were secured only one parasite to more than 50 weevils, the figures being 38 parasites to 1,998 weevils. The July and August, 1911, lots were from the whole region, and showed 590 parasites to 2,978 weevils. One locality can not show the average for the whole region; and moreover 1912 can not be taken as an index to 1911, for the conditions were different in the two years. The data show the need, however, for an exhaustive investigation of the proportion of parasites to weevils throughout the year, and the range of activity in temperature and relative humidity of the weevil and each of its parasites.

Longevity and Period of Inactivity

Adult weevils were kept alive for thirty-two days in Lima during July and August, 1912, without light or food, in a small closed pill-box, indoors, at a temperature of 64° to 66° Fahrenheit and during outside conditions of high relative humidity.

Mr. Rust noted in Piura during September and October, 1912, that thirty-three to forty-five days after collection of infested squares, while practically all adults of the weevil that had issued were dead, nearly all to a large proportion of the larvæ still left in the squares were alive. The relative humidity is markedly less during September and October in Piura than during July and August, which explains this larval retardation, the squares having been noted to dry rapidly during this season while in July and August they remained comparatively moist. It appears probable from this that the weevil lasts through the dry season largely in the larval stage as well as in the pupal and adult conditions. As the dryness increases from September to December, retardation of development in all stages becomes more and more marked until inactivity is reached, the return of relative humidity in Piura in May and June awakening the weevil to renewed activity. In all districts activity is lessened by a lowering of the relative humidity.

This period of inactivity, induced in both the square-weevil and the boll-weevil by atmospheric aridity, enables these insects to be

transported long distances and to establish themselves in new districts which furnish sufficient humidity coincident with food-supply during any considerable portion of the year.

Capacity for Damage

The capacity of the weevil for damage to the cotton crop is not so great in the Peruvian coast region as it would be in a tropical region that is truly humid throughout the year. But its damage varies considerably within this region, according to a variety of factors. Other things being equal, its damage in the various districts is directly proportionate to the annual duration of sufficient relative humidity to maintain its activity. It does the most damage in those districts where the bulk of the squares are formed during the most humid season of the year, providing that the temperature is sufficiently high during that season to accelerate rather than retard its development. From these facts it is evident that the damage is high in Piura, and probably still higher in the central coast region of Peru. Its average damage for the whole coast region must be considerably less than that of the boll-weevil in the more humid region of the southern United States, but it can hardly fall below 20 per cent. This means an annual loss to Peru from the weevil of about £400,000.

Work for the Future

Future work should consist of fostering the parasites of the weevil so far as practicable in the different districts; introducing and establishing one or both of the two species of ants above mentioned, *Solenopsis geminata* and *Ectatomma tuberculatum*, for attacking the early stages and adults of the weevil respectively, first ascertaining whether these two species are incompatible with each other or whether they may be maintained side by side in harmony, in the former case selecting the more effective of the two; and working out the details of the cultural control measures already outlined.

In order to carry these lines of work through intelligently, full data are needed on humidity and temperature ranges of the weevil and its enemies; and on both cotton varieties and cultural and irrigation methods adapted to the soils and climatic conditions of the different districts in the coast region. Such data can only be obtained by executing well-planned series of experiments in the laboratory and insectary in intimate connection with control work in the field.

UNSPOTTED TENTIFORM LEAF MINER OF THE APPLE

(*Ornix geminatella* Pack.)

By LEONARD HASEMAN, *Department of Entomology, University of Missouri*

The unspotted tentiform leaf miner of the apple has been exceedingly abundant for the past two or three years throughout the apple sections of Missouri. It has been gradually increasing in numbers for three or four years and probably reached a climax the past summer in this vicinity. In the orchard here on the horticultural grounds it has been so abundant that during the months of September and October it was almost impossible to find a single full grown apple leaf which did not have from one to twenty mines. Fortunately this type of leaf miner becomes most numerous from the middle to the latter part of the summer and therefore is not as destructive as it would be should its heavy work come earlier in the season.

The unspotted tentiform leaf miner has been known to science for many years, having been first imperfectly described by Packard in his "Guide to the Study of Insects" in 1869. Since that time a number of other names have seemingly been applied to the same species where it has been bred from the foliage of trees other than apple.

Life Cycle—For the past two years the writer has been studying this pest in its relation to horticulture in Missouri. In this study a number of interesting points have been determined with reference to its life cycle and habits. The pest in this vicinity invariably passes the winter in the pupal stage protected by a rather firm cocoon which is made somewhere along the edge of a leaf late in the fall. After the first heavy frosts come the leaves containing the cocoons and pupæ fall to the ground where they remain throughout the winter.

The past spring the first moths began to emerge in the insectary on April 17 and on May 3 they were fairly abundant in the orchard. From early May until late November either the adults or the caterpillars in the mines were found abundant here in the orchards. The life cycle is completed in from four to five weeks and five fairly distinct broods were made out in this latitude the past summer. The first brood completed its cycle early in June and about the same date each month following until October succeeding broods were to be found. The broods overlap considerably so that the pest does not have sharply defined generations but the periods at which the first appearance of the heavy attack of succeeding generations is noted may be rather sharply made out.

The parent moths are never very active though after they have emerged a day or two they are seen to fly about in breeding cages and in the orchard during the evening. When at rest the moth takes the characteristic position of other closely related moths, namely, standing with the tip of the wings and the end of the abdomen touching the object on which it rests and with the front part of the body propped up on the two front pairs of legs at an angle of 45°.

The eggs seem to be deposited during the evening and night and are placed singly on the lower side of the leaves. The egg is slightly oval in outline and exceedingly small, from .25 mm. to .4 mm. in length. The shell is beautifully sculptured both on the upper and lower side. This sculpturing is uniform over the entire surface and is so delicate that it requires very high magnification to bring it out. The sculpturing on the lower half of the shell is partially obliterated by the cementing substance which attaches it to the leaf. The writer has not succeeded in locating fresh eggs but from the appearance of the freshly hatched eggs, they seem to be quite flat.

Upon hatching the young caterpillar bores at once beneath the epidermis of the leaf. Not infrequently this tunnel is made through the lower shell of the egg.

For the first few days the caterpillar produces a serpentine type of mine which, to begin with, is not readily distinguished. After three or four days the caterpillar ceases to advance farther under the epidermis of the leaf and begins to eat out the cells on either side of the narrow serpentine mine, thereby producing a distinct blotch mine, and in three to four days more the blotch mine begins to take on the tentiform shape due to the drying out of the lower side of the leaf and to the tension produced by silk spun inside the mine by the caterpillar. The larva, therefore, in its development begins with a serpentine mine and ends with the characteristic elevated tentiform mine. After the tentiform mine is once produced the caterpillar feeds for a number of days upon the layer of chlorophyll cells immediately under the upper epidermis which causes the mine to take on a more or less transparent appearance when all of the chlorophyll has been removed. The mine is completed in from eight to fourteen days. The young caterpillar leaves a trail of fine excrement along the course of the serpentine mine and scatters it promiscuously throughout the blotch mine but in the tentiform mine it is largely collected in one end and may be partly covered with silk.

After the mine has been completed the caterpillar usually continues to inhabit it for a few days after which a small round hole is eaten through the lower side of the mine and the larva crawls about on the foliage and on the limbs of the trees in search of a suitable place to

pupate. Not infrequently it has been found to fold over the edge of the leaf and feed to a slight extent in a new place, though such cases are rare. The caterpillar on preparing to pupate draws over a portion of the edge of a leaf or folds over the edges at the tip of the leaf by means of silk threads and after lining this with silk it pupates, coming out a week to ten days later as the moth. It is interesting to watch the caterpillar tugging away at the silk threads as they are being attached and to see it tie these into bundles so as to shorten them and thereby draw down the edge of the leaf. There would seem to be quite a period between the appearance of the moths and the time at which the first eggs are deposited.

In the development of the caterpillar it passes through four larval stages. In the first stage it is footless, snow white except for a slight tinge of yellow on the head, and somewhat resembling a minute flat-headed borer. In this stage the larva makes the serpentine mine and in it changes to the second larval stage. This is also footless and white except for the head which becomes brownish and the first thoracic segment begins to take on a dorsal black blotch. While in this stage the mine is transformed into a blotch mine. With the change to the third larval stage, which occurs in the blotch mine, the head becomes darker, the thoracic blotch begins to take on the appearance of four irregular blotches and the six thoracic and eight abdominal legs appear. In this stage the larva increases in size rapidly and the body becomes darker. It is usually during this stage that the blotch mine is transformed into the characteristic tentiform mine. The change to the fourth larval stage takes place in the tentiform mine and usually before much of the chlorophyll layer of cells is consumed. In this stage the caterpillar has a brownish head with four dorsal black spots and four similar ones on the first thoracic segment and the body is dark grey with regular rows of white tubercles bearing prominent hairs. After feeding in the mine until mature the larva leaves it and prepares to pupate.

The unspotted tentiform leaf miner will probably never prove to be an exceedingly important pest of the orchard. One can hardly conceive of its ever becoming more abundant than it has been in the orchards of Missouri for the past two years and there is little sign of its having seriously injured either the trees or the apple crop the past summer. In case it does require special attention it can be checked by early spring plowing for the destruction of the leaves containing the wintering pupæ. Spraying has been carried on in the orchards here and has not had the least effect upon the development of the insect, due to the fact that the caterpillar is never ex-

posed to the poison upon the foliage except in those cases where it may feed to a slight extent after leaving the old mine.

In connection with the study of the development and habits of the miner, the writer has had an opportunity of noting the effective work of parasites. During the summer and fall various hymenopterous parasites were exceedingly abundant, so numerous in fact that only a very small percentage of each brood of miners succeeded in maturing. The majority of the miners are killed by small parasites when the mine is yet in the blotch stage, while many more are destroyed by other species of parasites after the mine takes on the mature condition. With the help of these various species of parasites there will probably never be any occasion for fruit growers to fear this miner. The various species of parasites reared from the mines of this caterpillar are now being studied by Prof. C. R. Crosby.

A NOTE ON TWO ELM LEAF APHIDES[1]

By Edith M. Patch

During the past few weeks several items concerning Elm leaf aphides which have come to my notice have interested me enough so that I venture to present them here, not as a formal paper, but merely to call attention to the fact that two perfectly distinct and easily distinguishable species causing elm leaf curl are present in the United States.

One of these migrates to *Pyrus* and *Cratægus* where it is known as the woolly aphid of the apple and that this species extends from the Atlantic to the Pacific coast nurserymen and apple growers almost everywhere can testify to their sorrow.

A second elm leaf species, which is present in California and elsewhere in the Pacific states, appears to be identical with a species recorded from England, Germany, Sweden, and elsewhere which has been ascertained by European workers to migrate from *Ulmus* to *Ribes* and is at present known as *ulmi* (*fodiens*) of Europe.

These two species can readily be distinguished by their antennæ. The *Ulmus-Ribes* species is characterized both in the spring and fall migrants by having joints V and VI without annular sensoria and the terminal sensorium of V is circular and fringed; the terminal sensorium of VI though somewhat irregular in shape being also fringed. The *Ulmus-Pyrus* species has typically annular sensoria on both V and VI in the fall migrant and on V in the spring migrant, while in both forms the circular sensorium of V is lacking, the terminal sensorium being

[1]Papers from the Maine Agricultural Experiment Station: Entomology No. 60.

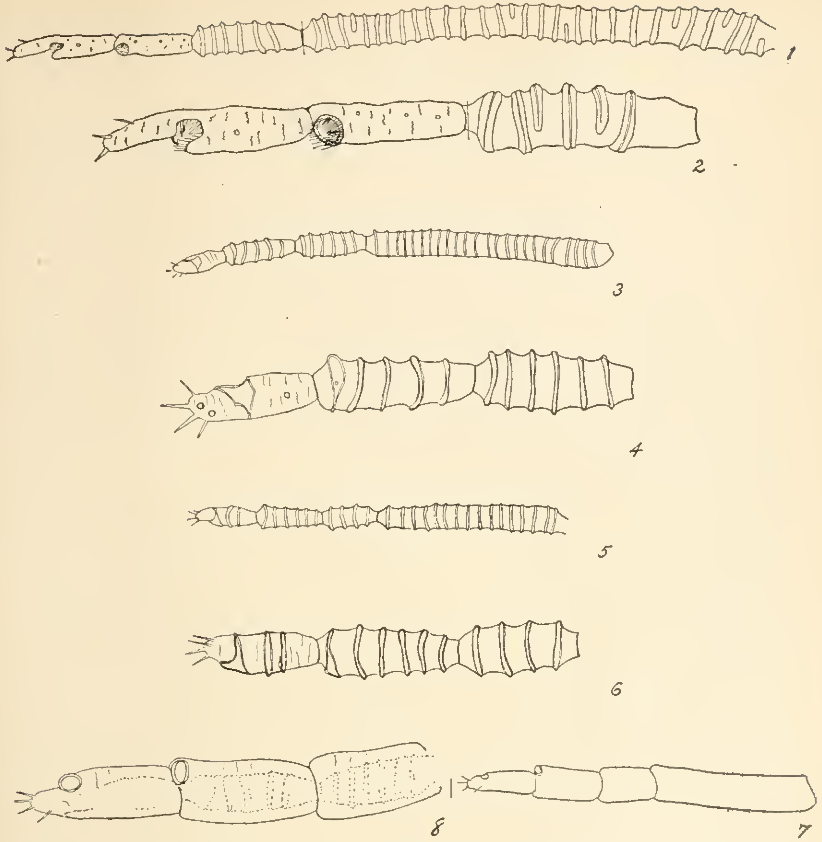

Fig. 3. 1 and 2 *Schizoneura ulmi* of Europe, fundatrigenia, migrant from elm leaf, collected in California; 3 and 4 *S. lanigera*, fundatrigenia, migrant from elm leaf, no. 9–12, winged progenitors of 9–12 sub. 1; 5 and 6 *S. lanigera*, sexuparæ-migrant from apple bark, no. 9–12 sub. 1, cage reared descendants of 9–12; 7 and 8 *S. lanigera*, pupa just before molt; (Figures 1, 3, 5, 7 are drawn to the same scale and figures 2, 4, 6, 8 are drawn to the same scale.)

annular and like the others, or, in many cases, variously modified and spread much like the terminal sensorium of VI. In the apterous forms and in the nymphal stages a circular terminal sensorium exists on both V and VI but these are lost in the winged form with the pupal molt.

That two elm leaf curling species of *Schizoneura* occur in other countries is certainly more than suggested by the figures of "*ulmi*" by Kessler (1878), Buckton (1881), Okajima (1908), Tullgren (1909), and Theobald (1912). The clue as to which one of these migrates to *Ribes* is sufficiently indicated by the figures of *fodiens* by Buckton, Tullgren and Theobald.

That the second elm leaf curling species of other countries is *lanigera*,

the life cycle of *lanigera* in United States is circumstantial evidence strong enough to serve as a working hypothesis and this question will doubtless be settled by European workers in due time.[1]

A BRIEF REPORT ON THE PIOJO BLANCO OF COTTON

By Charles H. T. Townsend, *Lima, Peru*

Arrival and Spread

This scale-insect, technically known as *Hemichionaspis minor*, has developed since 1905 into a serious pest of cotton in the Department of Piura. The species is more or less tropicopolitan and its country of origin is in doubt, but it seems quite certain now that it reached Peru from the humid coast region of Ecuador where it occurs on wild cotton at the present time. It evidently entered the Piura region at the port of Paita on shipments of plants from Guayaquil or Tumbes, and was thence carried in shipments by rail to the towns of Sullana and Piura. At these two places it established itself in the gardens and cotton patches near by, thus gaining a foothold.

It first attracted attention on cotton in the Piura valley near Piura town, in May, 1905, but was not noted as a pest of cotton in the Chira valley until 1907, and reached the upper cotton districts of the Chira around Somate in 1908. It was not noted on cotton in the southern districts of the Piura valley until 1910, having appeared at Santa Clara in February of that year. During 1910 it spread scatteringly southward from Santa Clara to near Sechura, thus completing the invasion of the entire cotton area of Piura Department in the Piura and Chira valleys. It reached the extreme upper cotton districts of the Piura valley, at Solsol, Paccha and Nómala in 1910; and was found by me in November, 1910, heavily infesting old tree-cotton at Macara, Ecuador, and on cotton as far up the Rio Macara as a point above the Hda. Limon Crossing.

The scale has been spread through the cotton districts of the Chira and Piura valleys by two agencies operating in contrary directions. The strong and long-continued winds from the south have carried

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[1]Since this paper went to press two marked publications from Germany have been received; one written by Dr. Carl Börner (*Kaiserliche Biologische Anstalt für Land— und Forstwirtschaft*, August, 1909) in which he suggests the probable necessity of a host plant other than the apple for the winter egg, stem mother, and the spring generation of the "Blutlaus," and the second by Dr. L. Reh, Hamburg, who, (*Der Praktische Ratgeber im Obst- und Gartenbau*, February 2, 1913, pp. 47–48), reviews both German and American observations on the "Blutlaus" and reinforces Doctor Börner's conclusions on the basis of his own fruitless searches of many years for the winter eggs of this aphid on apple.

it northward up both valleys. The waters of the two rivers flowing south and west, transporting it constantly into the fields during irrigation, have carried it generally southward especially in the Piura valley, and this in direct opposition to the prevailing strong winds. This explains its late invasion of the lower Piura valley.

Conditions Encountered in Piura, Including Enemies

This insect, like most diaspine coccids, if left undisturbed, is able to breed quite continuously under all the climatic gradations from warm humid to hot arid, provided only that its host-plant remains physiologically active. The cotton plant is active throughout the year in Piura Department, the climate is excessively arid from December to May and with considerable atmospheric humidity from June to November during the nights and forenoons. Practically no rain falls at any time of year. This climate is not duplicated anywhere in the world, and is only approached in a few districts like certain parts of northwestern Mexico, western Australia and perhaps southwestern Africa. The Piura region is much dryer than the central coast region of Peru. It is exceedingly interesting, therefore, from both the economic and biologic standpoints, to note what has taken place with reference to this insect and its enemies under the almost unique climatic conditions in question.

Having gained access to the Piura region, the insect either brought with it or was met there by certain microhymenopterous parasites common to diaspine scales in tropical and subtropical countries and by others especially American, as well as by still other enemies largely native to the country. The parasites and enemies now at work in some force on *Hemichionaspis minor* in Piura Department are as follows:

(1) *Aspidiotiphagus citrinus*—Tropicopolitan to temperate. Found in 1909 in both Piura and Lima. Known to oviposit in the active young of the scale, and thus possibly brought into the Piura region by the host, though more probably generally distributed with other scale insects before the advent of the piojo blanco. Abundant and evenly distributed. Both Piura and Chira valleys.

(2) *Prospaltella peruviana*—Peruvian. Found in 1909 in both Piura and Lima. Not nearly so abundant as the first, and while distributed everywhere it occurs unevenly and in fluctuating numbers. Both Piura and Chira valleys.

(3) *Prospaltella aurantii*—Tropicopolitan to temperate. Not found in Lima, and not in Piura till 1910 after liberations from North America in 1909. Its presence in Piura is therefore perhaps the

result of the importations from North America. Local and uncommon. Piura valley only.

(4) *Aphelinus fuscipennis*—Tropicopolitan to temperate. Found in 1909 in Lima, and in 1910 in Piura but probably existed in latter region before the liberations of 1909. Local and uncommon. Piura valley only.

(5) *Aphelinus quaylei*—Tropicopolitan. Found in 1909 in Lima. Not found in Piura until 1912, after liberations of much material from Lima. As yet recovered in Piura only from *Pseudaonidia* sp., but known from *H. minor* in both Ceylon and Hawaii and quite certainly at work on it in Piura. Locally numerous. Both Piura and Chira valleys.

(6) *Signiphora lutea*—Peruvian. Found in 1909 in both Piura and Lima. Common and rather evenly distributed. Both Chira and Piura valleys.

(7) *Signiphora occidentalis*—California to Barbados and Peru. Found in 1909 in Lima. Not found in Piura till after the 1910 liberations from Lima and the 1911 liberations from Barbados. Fairly numerous but unevenly distributed. Both Chira and Piura valleys.

(8) *Neosigniphora nigra*—Peruvian. Not found in Lima. Found quite abundant in the central Piura valley in 1910. Locally abundant. Piura valley only.

(9) *Arrhenophagus* sp. probably *chionaspidis*—Tropicopolitan to temperate in northern hemisphere. Not found in Lima, nor in Piura till 1912 after Japanese and Barbadoes liberations of 1911, which latter contained the species in abundance. As abundant as Aspidiotiphagus in many places, but not so evenly distributed. Both Chira and Piura valleys.

(10) *Microweisia vel* Gen. Aff. sp.—A very small black coccinellid, evidently native to the Peruvian and Chilean coast region. Very abundant and evenly distributed throughout both valleys.

(11) *Psyllobora* sp.—A pale yellow coccinellid of less than medium size with nine brown spots on each elytron, evidently native to the Peruvian coast region. Locally numerous, especially in the Piura valley, but distributed in both valleys.

(12) *Exochomus* sp.—A pale yellow coccinellid of less than medium size with six brown spots on each elytron, evidently native to the Peruvian coast region. Locally numerous in both valleys.

(13) *Hemisarcoptes malus*—Cosmopolitan mite. Very abundant and evenly distributed in both valleys.

(14) *Gamasidæ* sp.—Locally abundant. Piura valley only.

(15) *Sporotrichum* sp. probably *minimum*—Abundant and evenly distributed in both valleys.

The first nine of the above are microhymenopterous parasites that attack various diaspine scales; the next three are coccinellid beetles and the next two mites, all predaceous on the scale; the last is a white cottony fungus which attacks the scale. All of these fifteen enemies are very active during the more humid months from June to November, but unlike the scale they are unable to continue highly active during the very dry months from December to May. In a humid region like Panama or Ceylon, these enemies would completely dominate *H. minor* throughout the year. As it is in Piura, they practically succeed in dominating it by the end of the season of humid nights and mornings, about October or November and sometimes locally much earlier, but a certain small proportion of the young of the scale always escapes their attacks. The few young that escape, being relieved from the activity of their enemies, multiply in ever-increasing ratio during the extremely dry season from December to May until the plague assumes nearly the same proportions as the year before.

Indications suggest the possibility that the enemies of the scale may be slowly gaining on it from year to year in Piura. In 1910 it was difficult to find much living scale in November; in 1911 it was noted as very largely dead in October and locally so in September; while in 1912 it was found dead over certain considerable areas as early as July and August, and locally so even in June. Reliance should not, however, be placed on these indications, since a wide allowance must always be made for fluctuations due to factors beyond control, such as variations in climatic conditions and in activity of host-plant due to irregularity of water-supply.

Importation, Liberation and Distribution of Enemies

The following liberations of material imported into the Piura region from the outside, for the purpose of establishing enemies of *H. minor* not already occurring there, must be recorded. The scales used as vehicles were all diaspine, and care was exercised to prevent the escape of any species of scale not already present in the region.

United States—Three shipments of *Diaspis pentagona* from Washington, D. C. First abandoned in Piura town in August, 1909. Second liberated at Samán in November and December, 1909, some 700 microhymenopterous parasites by actual count being turned loose in the field as fast as they issued. Third liberated from Paita to Samán in February and March, 1910.

Lima—Two shipments of five boxes each, containing diaspine scales on Eriobotrya, Dracæna, Magnolia, Opuntia and Rosa. First liberated

at Chapairá in June, 1910. Second liberated at Catacaos in August, 1910.

Japan—Three shipments of the coccinellid beetle, *Chilocorus similis*, the first using *Hemichionaspis aspidistræ* and the other two *Diaspis pentagona*; and one shipment of *Diaspis pentagona* containing *Azotus* n. sp. near *capensis* and what was probably *Arrhenophagus chionaspidis*. The first coccinellid shipment, containing about 100 living beetles, was liberated at Catacaos in November, 1910; second, containing only three or four living beetles on arrival, was liberated in March, 1911, at Coscomba; third arrived with all beetles dead in August, 1911, and was put out at Coscomba. The parasite shipment was liberated at Coscomba in March, 1911.

Barbados—One shipment of *H. minor*, containing many Arrhenophagus and other parasites. Liberated at Catacaos in May, 1911.

The thanks of the Peruvian government are due to The Honorable Commissioner of Agriculture for the West Indies, for the Barbados shipment; to Mr. S. I. Kuwana, Imperial Entomologist of Japan, for the Japanese shipments; to Dr. L. O. Howard, Chief of the United States Bureau of Entomology, for the Washington shipments; and to Prof. Ch. Deneumostier, Director of the Escuela Nacional de Agricultura y Veterinaria, for the Lima shipments.

These shipments, though received at great disadvantage due to lack of proper facilities, have undoubtedly borne important fruit. Various species additional to those enumerated and quite certainly contained in them have not yet been recovered in Piura, but may nevertheless be found established there in the future, as the result of these liberations.

Thanks are also due to Mr. E. E. Green, Government Entomologist of Ceylon; to Mr. Charles P. Lounsbury, Government Entomologist of South Africa; to Mr. H. A. Ballou, Government Entomologist of Barbados; to Mr. F. W. Urich, Government Entomologist of Trinidad; and to Mr. E. M. Ehrhorn, Government Entomologist of Hawaii; all of whom sent valuable material of Hemichionaspis to assist in the preliminary search for suitable parasites; and to Mr. E. K. Carnes, Superintendent of the California State Insectary, who sent material from California.

During 1910 and 1911 one hundred and more different shipments of *H. minor* containing parasites were made between various points in the infested region of Piura, for the purpose of distributing the different species of parasites as evenly as possible through both the Chira and Piura valleys. Important results are already visible from this work, and further results from these shipments will no doubt appear as time goes on.

Of the fifteen enemies enumerated as now at work on the piojo blanco in Piura, probably the most effective at present is the small black coccinellid beetle, Microweisia (?) sp. Next to it in present effectiveness evidently come Aspidiotiphagus and Arrhenophagus.

Enemy Work for the Future

It is desirable that further enemies be imported, especially with the view of finding if possible one or more kinds that will continue high activity through the dry season in Piura. The most promising regions in which to search for such enemies are Sonora, Sinaloa and especially the Gulf coast of Lower California; also probably parts of western Australia and western Africa. Arid region coccinellids should be especially searched for and tried. The most promising restricted district that can at present be suggested for such search is on the Gulf coast of Lower California near the middle of the peninsula, opposite the Sonoran port of Guaymas and between the two settlements of Santa Gertrudis and Santa Rosalia. Of the whole peninsular of Lower California, noted as a land of drought and desert, this district receives the least rainfall and has the highest temperatures, with the minimum of atmospheric humidity during the year. Its coccinellids should therefore be able to continue activity through the Piura dry season. The dryest and hottest regions of western Australia should also be searched for scale-feeding coccinellids. All importations from excessively arid regions should be so timed as to arrive in Piura in December and January. This applies regardless of whether they come from points in the northern or southern hemisphere.

Present experience does not warrant further introductions into Piura of enemies from humid regions, except perhaps in the case of the coccidivorous fungi that have proved so successful against scale-insects in Florida. These fungi would probably flourish in Piura during the humid months, and might very materially decrease the number of the young scales that escape the present enemies. All importations from regions more humid than Piura should be so timed as to arrive in Piura during June and July.

Artificial breeding in the insectary of the three coccinellids now attacking the scale in Piura, *Microweisia* (?) sp., *Psyllobora* sp., and *Exochomus* sp., should be extensively pursued, especially with the first, during the months of August, September and October, for the purpose of producing as large quantities as possible for distribution, and such breeding should be continued through the dry season in the insectary by artificially supplying the requisite degree of atmospheric humidity. Distributions of these coccinellids should be made continually over the infested region during November and through

the dry season. If this plan be thoroughly carried out, it is quite probable that the relatively few young of the scale that now escape at the end of the humid season may be practically wiped out so as to prevent the increase that has heretofore taken place during the dry months.

The breeding work with native coccinellids should include at least four plans of handling. One lot should be gathered during the first week of August in the fields or taken from lots bred in the insectary, after about two months of high activity of the species, and subjected continuously in the insectary to artificial hot arid conditions for two months through August and September and the first week of October. This lot should then be distributed evenly through the infested districts during the second week of October, the natural relative humidity at this season being sufficient to awaken them immediately to activity. Under these conditions they should continue active feeding and breeding in the open well into the dry season, being incited thereto by their forced period of inactivity.

A second lot should be gathered and carried like the preceding till the middle of October, and then, instead of being put at once in the field, they should be subjected to high humidity in the insectary —higher than exists at the same season in the open, and bred in as great numbers as possible for weekly distribution through November and the succeeding dry months as long as they will last.

A third lot should be gathered in the field at the beginning of the humid season, the last week in May or the first week in June, and subjected continuously like the preceding two lots to artificial hot arid conditions until about the last of October, when they should be partly liberated in the fields and partly kept for breeding purposes in the insectary. These, having experienced a prolonged season of inactivity, should continue active longer into the dry season in the open than the first lot, providing that their vitality has not been lessened by their experience.

A fourth lot should be reared continuously in the insectary from June or gathered from the fields in August, and carried through in the insectary from September to May or as long as they will last, making distributions from the progeny as often as possible.

If this breeding of native coccinellids does not give the desired result, the Japanese *Chilocorus similis* and the Florida coccidivorous fungi should be tried in the fields during the humid season, carrying them both artificially through the ensuing dry season in the insectary and putting them out again in the field the humid season following. Should all of these measures, combined with such cultural control measures as can be devised, fail to wipe out the plague, then search

must be made for a dry-season enemy in Mexico or Australia, or both. If the native coccinellids can not be handled as above outlined, it is certain that the Japanese species can not be so handled. But coccinellids must certainly exist in Lower California and western Australia that can be so handled.

Cultural Control Measures

The investigations so far made in Piura indicate three important cultural measures that may be employed to advantage by the individual planter for the control of the piojo blanco on cotton. They may be outlined as follows:

(1) Cut out all infested plants other than cotton, such as castor bean, willow, melon, pigeon pea, beans, weeds, etc., since the cotton is continually reinfested from such plants. The scale appears to flourish at times on these plants when it has died out on the cotton in the vicinity, and thus such plants constitute a reservoir of infestation. Such reinfestation is especially liable to take place at the beginning of the dry season. Therefore such plants should be cut out during November and December and burned.

(2) Apply all the water that the cotton plants can stand without interfering with the proper ripening of the bolls and the gathering of the crop. The more water that can be applied to the fields the better, especially during the dry season. This has two results: *(a)* It stimulates the growth of the cotton plant so that it can better resist the attack of the scale; and *(b)* it supplies the necessary degree of atmospheric humidity in the fields requisite to maintain the parasites and enemies in active and effective condition. In carrying out this measure, it must be borne in mind that the cotton plant yields best if water is withheld during the maturing of the bolls, even to the point of practically drying out the soil; that application of water must be regulated to the physical constitution of the soil treated; and that a large part of the crop comes during the first half or more of the dry season, at just the time of year when it is particularly desirable to increase the humidity in the fields for the purpose of fostering the activity of the enemies of the scale. Again water is often not available when wanted, especially in the Piura valley during the first part of the dry season. All these points must be taken into consideration for operations in each district where practicable to employ this measure, and its advantages and disadvantages weighed against each other in accord with the conditions which govern that district until the proper balance of operation is struck. Careful laboratory and field station experiments are especially needed to determine these oper-

ation balances for the various districts, which differ largely in soil conditions and water facilities; as well as for different varieties of cotton, which differ as to the cropping-season possibilities.

(3) Cut back the cotton plants immediately after the gathering of the Christmas crop of the second or third year, or as soon as it is found that the preceding measures are not holding the scale in check sufficiently under the prevailing conditions to insure an average crop; when cutting back is no longer practicable, on account of age of plants, then replant from seed. The earlier the cutting back can be done at the beginning of the dry season, the more complete will be the control of the scale. The cut stalks should be burned if the cutting is done in the dry season, but if it is done at any time between June and October they should be simply piled up and left undisturbed for a month at least. November cuttings should be burned. These recommendations are made for the purpose of saving the valuable parasites and other enemies that abound on and in the scale from June to October, and which should not be destroyed. In carrying out this measure, it has to be borne in mind that some varieties of cotton can be cut back to advantage once a year, others every two years, and the native tree-cotton or pais variety not oftener than once in three years; and that certain districts are adapted to certain varieties and not to others, on account of peculiarities of soil and water-supply. Among the varieties adapted to the conditions of a particular district, other conditions being equal, that variety should be selected which can be oftenest cut back with advantage. Here again field station experiments are necessary to determine the most advantageous operative details.

Estimated Capacity for Damage in Piura

The area infested by the piojo blanco comprises the whole cotton region of Piura Department in the Chira and Piura valleys. A conservative estimate of the acreage in cotton in these two valleys would exceed 12,000 hectares or 30,000 acres. The product of this region equals ordinarily about 20 per cent of the whole cotton crop of Peru. As the native tree-cotton is the variety most largely cultivated and brings the highest price, the value of the Piura crop is equal to about £350,000 or nearly 25 per cent of the value of Peru's total cotton crop. The Piura crop should equal, on the above acreage, an annual value of at least half a million pounds sterling. The piojo blanco, if left to itself, will diminish the value of the Piura crop by at least 40 per cent. Its normal possibilities for annual damage in Piura are therefore in the neighborhood of £200,000.

A Piojo Blanco Quarantine

Peru needs to guard against the spread of this insect southward from Piura through the other cotton districts of her coast region. All the ports of the Peruvian coast south of Sechura should exercise a rigid quarantine against all the ports from Sechura to Panama, both inclusive, so far as plant importations are concerned. The piojo blanco exists in practically the whole west coast region from Panama south to Sechura, and infests a very great variety of plants. It may therefore be very easily brought to the uninfested region south of Sechura on almost any plant shipped from ports in the infested region. All plants entering Peruvian ports to the south of Sechura, arriving on vessels of whatsoever description from the north, should be subjected to the most severe scrutiny by competent persons, and if any scale of any kind is found on them, such plants should be completely destroyed. If they are merely scrubbed with insecticide and allowed to enter, the chances are ninety-nine to one that some of the microscopic young of the scale will escape the treatment and establish the plague at the port entered, whence it will later spread to the surrounding districts. The possibility of the piojo blanco gaining access to the cotton districts of the central coast region of Peru constitutes a most serious menace to the whole Peruvian cotton crop. While it is quite certain that the insect could not prove so injurious in the central coast region of Peru as it has in the Piura region, owing to the much greater atmospheric humidity prevailing in the former which would keep its enemies active during a greater part of the year, nevertheless its damage would quite certainly reach at least 20 per cent in any part of that region. It thus constitutes an impending menace, against which it behooves the Peruvian Government to guard to the limits of its ability.

A SUCCESSFUL TRAP FOR COCKROACHES

By F. L. Washburn, *Minnesota*

Mr. S. A. Graham of this Division has devised a simple trap for catching cockroaches, which works most successfully.

We have personally tried various contrivances on the market and others of our own devising, but find Mr. Graham's trap far better than anything we have met with. It consists of a flat-bottomed water flask, as shown in the accompanying drawing, in the mouth of which is introduced a paper cone (see illustration). This cone is held in place with a little vaseline smeared around the inside of the neck of the flask. The opening at the smaller end of the cone is $\frac{3}{8}$ of an inch in

diameter. It will be noted that a similar cone is placed in position within the larger one, the diameter of the small hole in the inner cone being the same as the smaller opening of the large cone. Both of these openings should be large enough for roaches to pass through easily. One side of the inner cone is glued to the outer cone.

In setting a trap a little banana is smeared around the inside of the cone as an additional attraction to the insects. A number of human hairs were glued, in some of our trials, to the inner cone at the smaller end (see illustration), but repeated trials indicate that these are unnecessary and add to the complexity of the otherwise simple trap.

The following baits were tried:

1. Milk—this worked very well in the dairy building, but gave poor results in other buildings.

2. Liquid chocolate gave poor results.

3. Banana peel; by far the most attractive, giving the best results of any baits tried.

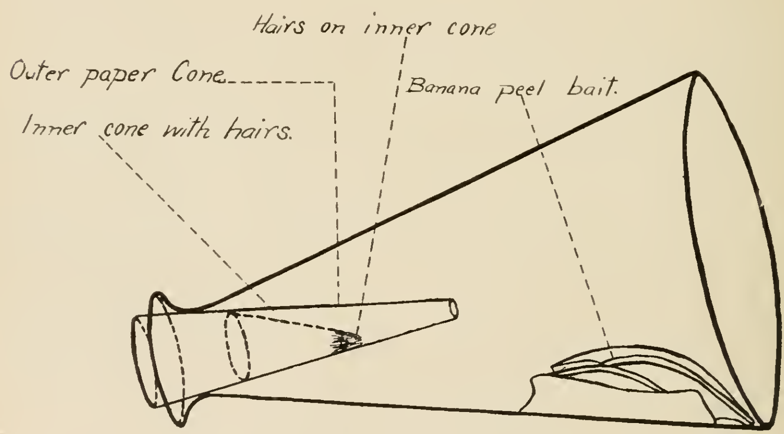

Fig. 4. Graham roach trap (original).

We took occasion to compare this simple trap, which we propose to call the "Graham Cockroach Trap" with the Hodge Fly Trap, which frequently catches roaches. The Graham Trap is superior to this for many reasons.

In the first place the Hodge Fly Trap has the bait outside of the actual trap, that is in the bait pan below the cone and its opening, so that a roach might crawl back (not seeking the light above as flies do) outside of the pan and make its escape; whereas, in a Graham Trap the bait is inside and the roach has to enter the trap before feeding. It is somewhat difficult for roaches to escape from the Graham Trap when once inside, which is clearly evident from observing its construction.

Very young roaches can pass through the wire mesh of the Hodge Fly Trap.

The statement is made above that the hairs appeared to be unnecessary. We found by observation that when the Graham Trap is placed in a secluded part of the room frequented by roaches, where it is not likely to be disturbed, there is little or no effort on the part of the insects to escape and the trap can be left unattended for possibly several days; on the other hand, if the trap was placed where light reached it in the morning and there was more or less activity and noise near it, the insects escaped under those conditions and the hairs made it somewhat more difficult for them to get out. Very few adult roaches are caught in the day time, but nymphs of all sizes enter the trap, apparently at all hours of the day.

We append some of the catches, indicating what the Graham Trap accomplished:

March	22	In 2 hours	30	Nymphs captured in Graham Trap.
"	24	" 5 "	5	Adults and 16 young.
"	24–25		25	" " 15 "
"	25	" day time	5	" " 17 Nymphs—different stages.
April	1		19	" " 5 "
In another Graham Trap same day			40	Adults and 12 Nymphs
Under Sink			10	" " 1 "Silver Fish"
The last three traps were set over night				
April	14		14	" " 44 Nymphs
"	10		5	" " 54 "

It occurred to the writer that, in view of the lack of success with many traps and the very marked success with the Graham Trap, the above was worthy of record. That the Hodge Fly Trap is useful in this connection, however, is evidenced by observations on the part of Mr. Williamson of this Division, upon two traps, baited with milk which was frequently renewed, placed in the kitchen of a steam-heated flat. The results are shown in the following table:

Trap I 1912		Trap II 1912	
Nov. 4–6	28	Nov. 15–17	12
" 6–8	30	" 17–19	12
" 8–10	25	" 19–26	17
" 10–12	26	" 26–29	14
" 12–14	19	" 29–Dec. 4	6
" 14–17	20	Dec. 4–5	16
" 17–18	11		
" 18–19	11	Total 20 days	77
" 19–26	26		
" 26–29	9		
Total 25 days	205		

Scientific Notes

An Acrobatic Fly. While collecting in Hocking County, Ohio, during the summer of 1911, the writer met with an interesting species of fly. In carefully scrutinizing the sandstone wall near the bottom of a gorge, he was surprised to observe a number of small insects, strung out in a row apparently floating in midair. A closer inspection afforded a novel sight. Thirteen minute flies were seen arranged at intervals along a long spider's thread which extended from one rock prominence to another. Each insect was hanging by the anterior pair of legs and careful inspection with the magnifier showed that they were using the terminal claws to grasp the fine thread. There they hung quite undisturbed by the swaying of the delicate line.

Upon lightly touching one with a small twig it would fly away a short distance, 6 to 10 inches, then begin to hover in the vicinity until it found the thread again. With one exception, each of the thirteen flies succeeded in regaining the thread which it would grasp much in the manner of a horizontal bar performer, its body swaying to and fro after the impact.

This interesting colony was observed frequently after its discovery. The number of insects present was different each time an observation was made, though there were never less than five or six. Whether the insects left at intervals in search of food and returned was a matter quite impossible to determine. There were very few long or short independent spider threads present in the vicinity and of those in use the longer invariably had the larger number of flies. It seemed to the writer probable that the insects did find their way back to their peculiar perch.

Specimens of the midges taken from the spiders thread have been found to belong to different genera. Dr. E. P. Felt has kindly examined them and refers them to the genera Microcerata and Bremia.

B. W. Wells.

A Probable Parasite of Scapteriscus didactylus in Cuba. Having received several inquiries about this insect from Messrs. Van Dine, Tower, Crossman, Jones and Hooker, entomologists of Porto Rico, I have been waiting for an opportunity to find out for them something about this insect in Cuba with a special watch for a parasite, for the situation stands thus: *Scapteriscus didactylus* Latr. known in Porto Rico as "changa" is quite a pest there, it exists in Cuba but is rare, although we have similar climatic conditions to those of Porto Rico, and its principal plant food, which is tobacco, is cultivated on a large scale. All this induces us to believe that here must exist a natural enemy that controls this insect.

Through Mr. G. N. Wolcott of the Bureau of Entomology, who at the time was doing special work here on tobacco insects and who went to San Juan y Martinez in the tobacco section of Pinar del Rio Province, we were able to find that *Scapteriscus* was known there and called "berraquito de la tierra" (little ground hog). With this information at hand I took advantage of a trip made to that section on account of a serious pest of wireworms on tobacco, being accompanied by Mr. Wolcott, and we found that what the people there called "berraquito de la tierra" was really the "changa" of Porto Rico or *Scapteriscus didactylus* Latr., and that the fire ant, *Solenopsis geminata* Fab., and the common red ant, *Pheidole megacephala* Fab., were their most dreaded enemies in high and dry land. To the attacks of these ants we partly attributed the fact that *Scapteriscus* has not proved a serious pest.

On a second trip made to San Juan y Martinez I paid attention to this matter of the "berraquito de la tierra." I had specimens brought to me, collected in high land where ants were very abundant, but evidently they had evaded them. Then I

decided to make another excursion to the place known as Galafre where we had found a number of specimens before. On November 30, 1912, while digging for "berraquitos de la tierra" and after collecting a few specimens, we found in the bottom of one of the borrows a cocoon of a hymenopterous insect that appeared to be a parasite, for attached to the outer threads of the cocoon could be seen the mandibles and the fore legs of a *Scapteriscus.* The pupa was still undeveloped but seemed to be that of a Myzinida. More cocoons were found and also a full grown larva spinning its cocoon.

Several cocoons were brought to the laboratory and at this date, April 7, 1913, were opened: three contained dead pupæ, and the other two much shrunken though still living larvæ. The cocoons were found in the bottom of what seemed to be *Scapteriscus* borrows, at a depth of from one to two feet, in a low and moist clay soil, near a brook; they are of a brown color and have two coverings, the one next to the insect is silky and hard, of elongated pear shape, the outer covering is very thin and loose. They measure about 1.6 cm. in length by .5 cm. in its broadest part.

Patricio Cardin,

Entomologist of the Agric. Exp. Station, Santiago de las Vegas, Cuba.

Gouty Pine Midge (*Itonida inopis* O. S.). Observations of last year (Econ. Ent. Journ. 5:368) and those of the present season show that under certain conditions this species may be of some economic importance, even though its host plant, the scrub pine, *Pinus rigida,* is not one of the most valuable trees. The latter part of May, 1912, the larvæ of this midge were very abundant at Karner, midway between Albany and Schenectady, N. Y., and similar conditions prevailed this season the last of April, the larvæ emerging with the appearance of several days of warm weather. Observations at this latter time show that a very large percentage, possibly half of the shoots were affected and, in some instances, 40 or 50 larvæ or cocoons were to be observed upon individual shoots. The swollen, injured area ranged in length from three to seven inches, the infestation producing an approximate doubling in the diameter of the twig and presumably interferes with the movement of the sap. One small scrub pine some six feet in height had nearly every shoot affected and it was estimated that over 1,000 larvæ or cocoons were to be found upon this tree, the vitality of which was much reduced, as evidenced by the short, pale needles. The injury by the preceding brood, that is larvæ hatching from eggs in 1911, showed as swollen, scarred pitchy areas. The growth beyond such points was apt to be less vigorous, and it appears probable that in some instances at least, this midge may be an important factor in reducing the vigor of young scrub pines, especially as it appears to be generally distributed and locally abundant. The brilliant orange, conspicuously tubercled larvæ issue so early in the season that they would ordinarily escape attention by most collectors, and this appears to account for the insect having been overlooked for so many years.

E. P. Felt.

Reorganization of the Gipsy Moth Work of the Bureau of Entomology.—During the past few months several changes have been made in the gipsy moth work in New England, carried on by the Bureau of Entomology, United States Department of Agriculture. Heretofore the work has been conducted along two separate lines, viz.: field work to prevent the spread of the gipsy and brown-tail moths, and laboratory work, which included the introduction of parasites and predatory enemies of these insects. There has been a reorganization and Mr. A. F. Burgess, who has been connected with the experimental work a number of years, has been placed in charge of the entire project. He will look after the administrative part of the work, and also have general supervision of the experimental work which will be carried on as heretofore.

Mr. D. M. Rogers will have charge of the inspection and quarantine work. Since the Federal Horticultural Board placed a quarantine on the region in New England infested by the gipsy and brown-tail moths, it has been necessary to devise and carry out a careful system of inspection to prevent the dispersion of these species on lumber, forest products, nursery stock, etc. The inspection of nursery stock is being carried on in coöperation with the inspectors in the states concerned.

The scouting work to determine the quarantine line, and also the scouting and control work to prevent the spread of the gipsy moth, has been placed in charge of Mr. L. H. Worthley. During the winter particular attention has been paid to the infestations along the northern and western borders of the outside infested territory and a large force of men has been employed to stamp out incipient infestations in this region and to examine the territory outside the border not known to be infested.

A new line of work has been taken up during the winter, as a result of experimental and field observation work, on the relation of different food plants to the gipsy moth. After consultation with the United States Forest Service an arrangement was made whereby coöperative work will be attempted, and a series of sylvicultural experiments have been planned and are being conducted by Mr. G. E. Clement in order to determine the relation of gipsy moth injury to the sylvicultural condition of the trees in areas where this insect is prevalent.

The parasite work will be continued along the same general lines, as heretofore, with special work to determine the increase and spread of the beneficial species that have been introduced from foreign lands. A long series of experiments will be continued to determine the preference of gipsy moth caterpillars for different food plants and this information will be supplemented by the work of a number of field observers. In addition, studies will be made during the year to determine definitely the increase or decrease of the species in areas which have been specially selected for this purpose. These areas are well scattered over the entire infested territory and the tree growth which is found throughout the region is well represented in them. As a result of these experiments it is hoped that much data may be secured which will have an important bearing on the susceptibility of different trees and shrubs to gipsy moth attack, as this information is of utmost importance in determining the best methods of thinning woodland.

An investigation on the "wilt" disease is being carried on in coöperation with the Bussey Institution, Harvard University. The technical aspects of this work are being directed by Dr. W. M. Wheeler of that Institution, and Mr. R. W. Glaser, who has made a special study of the organism which is responsible for the "wilt" disease, is carrying on a large number of investigations.

The insects which attack trees that are defoliated or weakened by the gipsy moth are being given special study, particularly those species which attack oak. This work is being carried on coöperatively with the Branch of Forest Insect Investigations of the Bureau of Entomology, and Dr. A. D. Hopkins, who has charge of these investigations, is directing the work on this project. An extensive series of experiments is being carried on to determine the methods by which the gipsy moth is spread. Special attention is being paid to the spread of young caterpillars by wind, and also the relation of velocity and temperature to wind spread. An effort is being made to determine how far small caterpillars can be carried in this way. These experiments are of vital importance as they have a definite bearing on the kind and amount of hand work which should be carried on in the towns outside the known infested area.

The Boston office, which has, for a number of years, been located at 6 Beacon Street, was moved May 5 to the Carney Building, 43 Tremont Street, and communications by mail should be sent in the future to that address.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The campaign against the house fly is being vigorously pushed. New fly traps have been devised in the last few months. In this issue a new cockroach trap is described. These efforts are all praiseworthy, though they are defective in that they fail to go to the root of the evil. The entomologically sanitary premises and dwelling is a development for the future. Progress is being made so far as the premises are concerned, though little seems to have been attempted by architects in designing dwellings which shall be moderately pest-proof. A study of household pests shows this is less difficult than the surgically clean operating room of the hospital. It would seem as though a few moderately expensive changes in the construction of our dwellings would aid materially in eliminating the more obnoxious of our household insects.

The appearance of two volumes of the long expected monograph on mosquitos by Dr. Howard and his associates, marks an important epoch in American entomology. The work, noticed elsewhere in this issue, embodies high scientific ideals, is a classic, and is destined to exercise a profound influence on the scientific investigations of the future. Contributions of this general character are potent factors in placing both economic and systematic entomology upon a thoroughly sound, scientific basis. The writer has long been of the opinion that substantial progress in our branch of science will be made largely by investigations continued for a series of years in connection with, and really an extension of the numerous supplemental studies which must be made from season to season in solving immediate practical needs. Every working entomologist should so plan his efforts as to have a reasonable amount of time each year for purely scientific studies, even though their practical bearings may be somewhat remote.

The recently issued Proceedings of the British Columbia Entomological Society shows a most commendable activity, and we take this opportunity of extending the hand of good fellowship to the entomologists of the Northwest. This society, organized in 1901, has been

quiescent for a time and now, through the efforts of a few energetic leaders, is doing excellent work in recording entomological data and awakening an interest in a most practical phase of agriculture, the control of injurious insects. The Proceedings contain many interesting local records from the various districts, beside a number of special papers, efficient quarantine work being given a good share of attention. This organization is fortunate in receiving a moderate amount of aid through ministerial grants, and we trust that this is only the beginning of better things for the future. There are many general as well as local problems and we look to the Northwest for the assistance it should render, confident that the trust is not misplaced.

This issue gives an outline of the reorganization of the gipsy moth work conducted by the Federal authorities. The comprehensive character of this project is highly commendable. The investigations relative to the spread and efficiency of various parasites and the feeding habits of the gipsy moth caterpillar will give data of fundamental importance in determining the most profitable methods for the future. The prevention of the spread of this pest through the shipment of infested materials and the early detection of outlying infestations are of vital importance in the control work of the immediate future. The gipsy moth problem is one of National importance, and states liable to invasion by this pest must look more and more to Federal agencies for protection from such insects which, if left to themselves, would soon become widely established and inflict enormous losses. The gipsy moth work has received the hearty and almost unanimous support from the economic entomologists of America, and the authorities in charge may confidently expect equally gratifying endorsement in the future.

Obituary

CHARLES WORCESTER HOOKER

Charles Worcester Hooker, entomologist of the Federal Experiment Station, at Mayaguez, Porto Rico, and plant inspector at the Port of Mayaguez for the insular government, died at Mayaguez on February 12, 1913, from an attack of appendicitis.

Doctor Hooker was born at Westhampton, Mass., April 13, 1883; he attended the public schools of that town until June, 1893, when he moved with his parents to Amherst, Mass. He graduated from the Amherst High School in June, 1902, and entered Amherst College the following fall, graduating in 1906. While at Amherst he elected

Charles W. Hooker

the courses given in zoölogy by Drs. John M. Tyler and F. B. Loomis. In September, 1906, he entered the graduate school at the Massachusetts Agricultural College, electing entomology, given by Drs. C. H. and H. T. Fernald, as his major subject, and cryptogamic botany and horticulture as his minor subjects. He acted as a state nursery inspector during the summers of 1907 and 1908. The degree of Ph. D. was conferred upon him in June, 1909, and he at once accepted an appointment with the Bureau of Entomology of the United States Department of Agriculture, working under the direction of Prof. A. L. Quaintance, being detailed to investigate the life histories and habits of cranberry insects in Wisconsin. He spent the balance of the growing season of 1909, and all of the season of 1910, in Wisconsin, with headquarters at Cranmoor. He accomplished a large amount of very valuable work while in Wisconsin and submitted manuscript, now in process of publication by the Bureau, of what appears to be a very complete account of the biologies and habits of the more important cranberry insects in that state, including references to very many other species which he found occurring on the plant.

Doctor Hooker was promoted one grade January 1, 1911. That spring he was transferred to the Government field station at Vienna, Va., and assigned to work on the Coccinellidæ with special reference to determining the comparative economic value of the different species, and also to investigate the biologies and habits of the more important species to furnish information for a better understanding of methods which should be employed in their propagation and dissemination to effect the control of noxious species. A good start was made on this work during the year previous to his resignation.

Doctor Hooker was appointed to the position he held at his death, in October, 1911. He returned to the States on leave of absence during the summer of 1912 and was married on July 3, at Amherst, Mass., to Miss Elizabeth R. Wiley. Doctor Hooker's body was brought to Amherst, Mass., and interred in Wildwood Cemetery on February 22.

As a student Doctor Hooker made many friends by his genial ways and quick appreciation of the interests of others. Of his work after leaving Amherst, his chief, Professor Quaintance writes: "He had proved himself to be a very conscientious and faithful worker and inspired the esteem and affection of all who came in contact with him. I regard his untimely death as a very severe loss to the science of Entomology, both economic and in its broader aspects." His loss will long be felt by all those who knew him.

H. T. F.

WRITINGS OF C. W. HOOKER

A New Cecidomyiid on Oak (Ent. News, 19, 1908, No. 8, pp. 349–352, Pl. 1). (H. M. Russell associate author.)

The Periodical Cicada in Massachusetts (Massachusetts Sta. Report, 1908, pt. 2, pp. 200–210).

Fumigation of Cucumbers (Massachusetts Sta. Report, 1909, pt. 1, pp. 227–247).

The Ichneumon Flies of America Belonging to the Tribe Ophionini (Trans. Am. Ent. Soc., 28, 1912, No. 1–2, pp. 176+176a–176c, Pls. 3).

Report of Entomologist (In course of publication).

Report on Cranberry Investigations (Now in course of publication).

A paper to be issued as a bulletin or circular of the Porto Rico Station.

Reviews

The Mosquitos of North and Central America and the West Indies, by L. O. Howard, H. G. Dyar and F. Knab. The Carnegie Institution, Washington, D. C., quarto, Vol. 1, p. i-vi, 1–520; plates 1–14; Vol. 2, p. i–x, plates 1–150. 1912.

A decade of work has come to partial fruition in two volumes of a magnificent monograph—a work highly creditable alike to the authors, the numerous collaborators and the institution standing sponsor for the undertaking.

The first volume, introductory and practical in nature, presents in a condensed form a wonderful amount of information and is a logical introduction to the systematic discussion in the third and fourth volumes. The magnitude of the task has prevented the authors and their collaborators from investigating all phases of the subject, and we find throughout this first volume, excerpts from the writings of various investigators. The authors have given particular attention to the historical development of our knowledge of mosquitos along various lines and great care has been exercised in giving credit to different parties.

The introduction outlines the causes resulting in the recently developed great interest in mosquitos, records briefly the typical regions in which the Culicid fauna was studied and acknowledges the services of many collaborators. The next few pages give a vivid idea of the pestiferous potentialities of mosquitos, and this is followed by a summary of earlier accounts relating to Culicid biology. The structure of the adult is discussed in 59 pages, that of the internal anatomy being from Stephens and Christophers. The consideration of the larva is an excellent morphologic and taxonomic exposition and gives, within a small compass, a good idea of the development of these forms. The behavior of the adults has been carefully studied by the authors, there being detailed observations on the food habits, song, hearing, longevity, hibernation, mating, the superabundance of mosquitos, especially in the northwest and Alaska, and the deposition of eggs.

The importance of a knowledge of mosquito larvæ is fully recognized and we find a succinct though comprehensive account of their habits, food and natural enemies, the latter topic occupying 21 pages of text.

The place of the mosquito as a disease carrier is fully discussed, this topic including detailed accounts of the important disease carriers, namely, the malaria and yellow fever mosquitos, and occupying over 130 pages. There is most suggestive data on the losses caused by malaria and an exceedingly instructive discussion of the decrease and increase of this disease following settlement of the country and the attention or lack of

attention to drainage. There is a very full discussion of yellow fever and the earlier outbreaks of this disease, the yellow fever mosquito in its various relations and practical means of controlling the pests. We find assembled in these pages, much data, historical, sanitary and scientific, which is invaluable and necessary to the successful control of these scourges of mankind. The scope of this study is suggested by such topics as the original home of the yellow fever mosquito, its distribution in America, length of life of the imago, distance of flight, mosquitos biting cadavers, and mosquitos in the courts of law, to mention only a few.

About 90 pages are devoted to antimosquito work, protection from adults, destruction of larvæ, etc. The elimination of breeding places is discussed largely in accounts of work done in various communities, both domestic and foreign. There is an extended and well selected bibliography and a detailed index.

The second volume is composed entirely of plates and their explanations, the latter reduced to a minimum and open to the criticism that no indication of the enlargements is given. A number of these figures have been published in connection with earlier papers by one or more of the authors, though this does not in the least detract from their scientific value. The figures of entire larvæ on plates 42–85 are a noteworthy contribution to the art of scientific illustration. They are accurate, attractive, and yet none too large to show the complex structure of these organisms.

A work of this character can not be too highly commended, though costly in men, time and money. There is urgent need of more such monographic studies, investigations which not only elucidate obscure problems and lay the foundation for successful practical work, but which also serve as a vigorous stimulus for similar studies in other lines and thus, indirectly at least, may have a very far-reaching effect. The authors are to be congratulated upon having produced such a meritorious work, one which will be the basis for all subsequent investigations in this very important group.

The complete work, consisting of four volumes, may be obtained through the Carnegie Institution of Washington (16 Twelfth St.), for $10.00, the unpublished volumes to be forwarded as soon as issued.

Current Notes

Conducted by the Associate Editor

The legislature of Minnesota has passed a Foul Brood Law.

Prof. C. F. Baker has recently been appointed professor of agronomy in the University of the Philippines.

Prof. H. A. Morgan, director of the station, has been appointed dean of the Tennessee College of Agriculture.

Mr. David Sharp of England and Dr. J. H. Fabre of France, have been elected honorary members of the Entomological Society of America.

The Pacific Slope Association of Economic Entomologists, held its fourth annual meeting at the University of California, Berkeley, April 10–12.

Dr. E. P. Sandsten has been appointed professor of horticulture in the Alabama College, and horticulturist of the Station, *vice* P. F. Williams, deceased.

Recent provision has been made for increased laboratory facilities for the Department of Entomology of the Nova Scotia Agricultural College at Truro.

Prof. S. J. Hunter of the University of Kansas was elected a member of the Board of Education of the City of Lawrence, at the recent election, April 1.

N. E. Shaw, chief nursery inspector of Ohio, held a public demonstration of pruning and spraying at the orchard of D. J. Cable, German Township, April 9–10.

George A. Smith, government agricultural demonstration agent, has been appointed inspector of nurseries and orchards for the Beaumont district, Texas.

Prof. R. W. Doane of the Department of Entomology and Bionomics in Leland Stanford Jr. University is investigating certain pests of the cocoanut trees of Samoa at the request of some of the growers.

The department of entomology, University of Nebraska, will soon be housed in a new building that will cost $85,000, and which will also contain the departments of horticulture and of agricultural botany.

Dr. Henry T. Fernald, professor of entomology, Massachusetts Agricultural College, sailed April 28 for Europe where he will visit a number of museums to examine type material, returning to America about the middle of September.

Paul Smith Welch, A. M., fellow in zoölogy, University of Illinois, will give instruction in entomology during the summer at the Biological Station of the University of Michigan, Cheboygan County, Michigan.

The honorary degree of D. Sc was conferred upon Prof. E. B. Poulton, on the occasion of the installation of the Duke of Northumberland as Chancellor of Durham University.

Dr. C. D. Jarvis, horticulturist of the Storrs Station in Connecticut, has severed his connection with the station and will have charge of the agricultural extension work of the state conducted jointly by the United States Department of Agriculture and the Connecticut Agricultural College.

A school for beekeepers was held at the Massachusetts Agricultural College, May 28 to June 11, under the direction of Dr. Burton N. Gates. Doctor Gates attended the annual meeting of the Connecticut Beekeeper's Association at Hartford, Conn., April 19.

A State Crop Pest Commission has recently been established in West Virginia with an appropriation of $10,000 per annum. This commission is composed of the director of the station, the commissioner of agriculture, the president of the State Horticultural Society and the station entomologist is *ex officio* State Entomologist.

Announcement is made of a beekeeper's convention to be held at the Agricultural College, Amherst, Mass., June 11 and 12. The program includes papers by Dr. B. N. Gates, E. R. Root, Morley Pettit, Ontario, Can.; Dr. Chas. G. Schamu, Syracuse, N. Y., and many New England beekeepers and apiary inspectors.

Mr. James F. Zimmer, formerly in charge of the insecticide testing laboratory of the Bureau of Entomology at Vienna, Va. has resigned in order to accept a position as assistant state leader in farm management at Manistee, Mich. His duties will be to assist the fruit growers and farmers along the eastern shore of Lake Michigan.

Mr. Donald J. Caffrey, who for three years has been assistant to the State Entomologist of Connecticut, in charge of the field work against the gypsy and brown-tail moth, resigned May 15 to accept a position in the Bureau of Entomology, in connection with cereal and forage insect investigations. He has been assigned to work on the range caterpillar in New Mexico.

Science is authority for the statement that "The teachers of the Norman School at Avignon, of which M. J. H. Fabre, the entomologist, was a pupil, are taking steps to erect a monument in his honor. The council of Vaucluse has voted 1,500 francs to the fund."

Mr. S. S. Crossman, entomologist of the Board of Commissioners of Agriculture of Porto Rico, has recently moved his residence from San Juan to Aibonito. He is engaged in studying the tobacco insects of Porto Rico, the two worst ones being the mole cricket, *Scapteriscus didactylus* and a species of flea beetle.

According to *Science*, J. M. Aldrich, professor of Zoölogy and Entomology at the University of Idaho, has been forced to retire after twenty years' service. The details of this action are explained by Professor Vernon L. Kellogg in *Science* for May 16, page 751. Professor Aldrich, who is an eminent dipterist, has accepted a position with the Bureau of Entomology at Washington.

Michigan has recently enacted a new Foul Brood Law with an annual appropriation of $1,500, which should provide for effective work. Though the administration of this measure is under the State Board of Agriculture, this board has placed it in direct charge of Prof. R. H. Pettit, entomologist of the Agricultural Experiment Station, who has appointed Mr. McMillen, of Guelph, Ontario, as inspector.

Dr. M. C. Tanquary, instructor in entomology at the Kansas State Agricultural College and assistant entomologist in the Kansas State Experiment Station, has been granted a leave of absence and will accompany the Crocker Land Expedition, which is to leave New York City July 2 for the Far North, under the auspices of the American Museum of Natural History of New York. It is also supported by the American Geographical Society, the University of Illinois, Yale University, Bowdoin College, New York Academy of Science, and several individuals, including Colonel Roosevelt and Admiral Perry. Doctor Tanquary will have charge of the zoölogical and botanical research work.

The recent session of the Montana Legislature enacted a law creating the Montana State Board of Entomology, whose duty it is to "study the dissemination by insects of diseases among persons and animals, said investigation having for its purpose the eradication and prevention of such diseases." The board is further required to take steps to eradicate and prevent the spread of diseases that may be transmitted by insects and an appropriation of five thousand dollars a year for the next biennium is made. The immediate object in passing the law was to provide for the eradication of the Rocky Mountain spotted fever tick. The membership of the board is *ex officio* and is made up of the secretary of the State Board of Health, chairman; the State Entomologist, secretary, and the State Veterinarian.

According to *Science* Dr. Paul Marchal, chief of the Entomological Station of Paris, Professor in the Agronomical Institute of France, and a member of the French Academy of Sciences, landed in New York May 4. He comes to America for the purpose of studying the organization of the Bureau of Entomology of the Department of Agriculture at Washington and other organizations working in applied entomology and will remain in the United States for two or three months. Dr. Marchal is especially well known to general students of biology and morphology on account of his remarkable researches in polyembryony. In the course of his stay he will visit most parts of the United States.

Congress has furnished the Bureau of Entomology with funds to be used in the eradication of the tick which transmits spotted fever in the Bitter Root Valley in Montana. Doctor H. T. Ricketts demonstrated that the disease is transmitted only

by the tick, *Dermacentor venustus*. Investigations conducted by the Bureau of Entomology in coöperation with the Montana Agricultural College have shown that a comparatively simple and inexpensive plan of eradication of the tick may be put into operation. Coöperation has been arranged with the Montana State Board of Entomology which, under recent action of the legislature, has full authority to prescribe quarantine and other regulations that may be necessary for the work.

Federal Horticultural Board. Quarantine notice No. 7 forbids the importation from Europe of all five-leaved pines (*Pinus albicaulis, aristata, ayacahuite, balfouriana, bonapartea, cembra, excelsa, flexilis, koraiensis, lambertiana, mandschurica, monticola, parviflora, pentaphylla, peuce, pygmaea, strobiformis, strobus*) and their horticultural varieties.

The recently issued circular 44 of the office of the secretary of agriculture replaces circular 41, amplifies the classification of plants hitherto given on the permit, changes regulation 3 to correspond with the new form of permit (one permit authorizing importation for the season); regulation 5 is modified to include plant quarantine decision No. 2; regulation 7 is altered by the addition of the term "exporter"; the part of regulation 6 becoming of non effect after July 1 next is omitted and provision made for treatment of infested nursery stock from countries without an official inspection system; regulations 9 and 11 are omitted—these changes all being in the nature of corrections of errors (see circular of information No. 4). Circular of information No. 3 deals with foreign inspection and certification requirements.

NATIONAL COMMITTEE ON ENTOMOLOGICAL NOMENCLATURE

The Second International Congress of Entomology at Oxford during 1912 unanimously passed certain resolutions, creating and directing an International Committee on Nomenclature. Among the duties of this committee are:

1. To enter into communication with the entomological societies of the world with the view of forming national committees on entomological nomenclature.

2. To collect, in coöperation with the national committees, the opinions of entomologists on questions of nomenclature as affecting entomology.

3. To consider what elucidations, extensions, or amendments, if any, are required in the International Code.

4. To confer with the International Commission on zoölogical Nomenclature, and

5. To lay a report before the next Congress of Entomology (in 1915).

It will be noted that this committee is directed to enter into communication with the various entomological societies in order to form national committees on nomenclature. Dr. Karl Jordan, secretary of the International Committee, has performed this service for the European societies, and at his request Mr. Nathan Banks has undertaken similar work for the American societies. Mr. Banks now desires the appointment of two members from the Association of Economic Entomologists to serve on the American National Committee, and I have therefore asked Professor Herbert Osborn, of the University of Ohio, and Dr. A. D. MacGillivray of the University of Illinois to act in this capacity, which they have kindly consented to do.

P. J. Parrott.

May 22, 1913. *President of the Amerìcan Association of Economic Entomologists.*

Mailed June 16, 1913.

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SOME METHODS OF HANDLING MINUTE HYMENOPTEROUS PARASITES[1]

By T. E. Holloway, *Bureau of Entomology, U. S. Department of Agriculture, Audubon Park, New Orleans, La.*

A year or so ago the writer had some experience in rearing and shipping the hymenopterous egg parasites, *Trichogramma minutum* (*pretiosa*) Riley and *Telenomus* sp. (probably *heliothidis* Ashmead). An account of this work has not been published, and the suggestion [2] has been made that the writer prepare a paper on his methods of dealing with these small insects. Though *Telenomus* is more difficult to rear than *Trichogramma*, the methods given below which were devised for the work with the latter species were found to be suitable for the former also.

At the beginning of his work the writer had the advantage of some suggestions which Mr. W. F. Fiske made to Dr. L. P. de Bussy, who transmitted them in the following words:

"He (Mr. Fiske) handles the insects in very narrow tubes (2–3 mm. in width and ½–1 inch long); in this way it is very easy to study them with a lens, to see the antennæ and to know the sex.

"*Trichogramma* breeds parthenogenetically for long generations, if necessary. Mr. Fiske thinks it parasitizes any soft-shelled eggs, but probably only when the larva inside has not yet developed too much. Infertile and dead eggs (after several months of cold storage) will be infested too, and perhaps also ovarial eggs, although this has not been studied.

"An egg will not give any *Trichogramma*, when it is very often infested by one or more females. The best way is to give 25 to 50 host eggs to one female *Trichogramma*. Once, as many as 163 *Trichogramma* have been bred from two females.

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[1] Published by permission of the Chief of the Bureau of Entomology.

[2] This suggestion was made by Mr. Geo. N. Wolcott, assistant entomologist of the Board of Commissioners of Agriculture in Porto Rico, who has done much work in rearing and shipping *Trichogramma* and other parasites.

"Therefore a very large quantity of host eggs is a principal question. Mr. Fiske had infested eggs in cold storage (28–30° F.) for about ten months, after which time the adults emerged normally. It is necessary to put the infested eggs in the cold temperature at the moment when they are beginning to turn black."

The easiest and almost the only way of collecting very small egg parasites is to collect eggs parasitized by them, and to rear the parasites from the eggs. The collected eggs should be separated as well as possible from the leaves or corn silk (in the case of *Heliothis* eggs) on which they were deposited. They should then be put in glass tubes about 8 mm. wide by 24 mm. in length, about ten or fifteen eggs to a tube. A piece of fine cotton batting is very good for use as a stopper. The eggs which are not parasitized will usually hatch before the parasites emerge from the other eggs. The larvæ from the unparasitized eggs should be removed from the tube.

The parasites may be expected to emerge within a short time after the eggs turn black. Sometimes several adults of *Trichogramma* emerge from one egg, so that quite a number of parasites may be found in the tube. A very weak solution of granulated sugar and water should be made and this should be given to the parasites. A good way to feed these minute insects is to moisten the pointed end of an insect pin with the sugar solution, and to insert it into the tube, around the cotton stopper but without removing the stopper. Some of the sugar solution should be made to adhere to the side of the tube, and then the end of the pin should be withdrawn. Only a small amount of the sweet solution is necessary for the parasites. The amount should be so little, in fact, that it cannot be observed very well except with the aid of a pocket lens. If much liquid is given to the parasites they will usually be caught in it and will be unable to free themselves. Naturally, the liquid should not be so thick as to be sticky. A sugar solution which is merely sweetened water is best.

Copulation will occur soon after both males and females have emerged from the eggs in the tube. The experience of the writer indicates, however, that it is best to leave the females with the males for about twenty-four hours before giving them host eggs for oviposition. If a female is given host eggs within a few hours after emergence it seems that there is some possibility that she may escape fertilization.

When it is desired to have the parasites oviposit, they may be introduced into a tube (size 8 mm. by 24 mm.) in which a number of fresh host eggs, or host eggs which have been kept in cold storage, and a minute particle of the sugar solution have been placed. (The writer did not use the very small tubes recommended by Mr. Fiske because he could not obtain them readily.) The manner of transferring the

insects from one tube to another will be described below. In placing the parasites with fresh eggs the males may be left out of consideration. In a tube where the females are ovipositing the males walk about aimlessly and do not disturb the females. The important thing is to get some females in the tube with the fresh eggs. The females of *Trichogramma* may easily be distinguished by the antennæ, though the living individuals usually move so rapidly that it is difficult to determine the sex in any way whatever. The action of the different sexes in the presence of the fresh eggs is positive evidence, however. While the males will pay no attention to the eggs, the females—as soon as they have become accustomed to their new location—will busily examine a number of the eggs, crawling over them and tapping them with the antennæ, and finally selecting some for oviposition. One egg after another will then be parasitized. The writer found it most convenient to place two or three females in a tube containing about fifty eggs. One female to about twenty-five host eggs may be correct.

In transferring the parasites from one tube to another, it was found best to place the tubes on a smooth white surface so that the insects might easily be observed. A plate of glass five by seven inches, with a piece of white paper glued to the underside, was used for this purpose. The plate of glass was placed on a table before the worker. At the worker's right hand was a very fine camel's hair brush, a fine insect pin, and a watch glass containing the sugar solution. The parasite tubes were placed at the left of the worker. A few parasites were allowed to come out on the glass plate, and they were then made to walk or jump into the proper tube, which was held open before them. If necessary, the parasites were touched *very slightly* with the camel's hair brush so as to make them go in the right direction. Occasionally, a parasite would escape, but after the operator acquired some experience there was little loss.

Another way to transfer the parasites from tube to tube is to open the two tubes and hold them mouth to mouth. The tubes should be of the same size, and the mouths should be held firmly together. If there are a large number of parasites in one of the tubes, however, too many will usually go into the new tube. In this work advantage should be taken of the fact that the parasites will ordinarily go toward the source of light. The tubes should be arranged so that the parasites will proceed from the old tube to the new one in the direction from which the light comes.

The tubes should be kept in a suitable tray on a piece of white paper, so that the parasites may be observed. A small label bearing a num-

ber may be glued to each tube so that a record may be kept of the work.

For shipment, the tubes containing parasitized eggs may be packed in pasteboard mailing cases. In the work with which the writer was connected, a little cotton batting was placed in each tube to prevent the eggs from shaking, but Mr. S. Leefmans, who received the eggs in Holland, suggested that pieces of very thin paper be used instead of cotton, as the parasites on emerging were liable to become entangled in the cotton. The writer does not know whether the thin paper was more satisfactory than the cotton. Each tube should be packed in cotton in a tube that is somewhat larger, and the larger tubes should be packed in cotton in the case. If cold storage is used—and it is desirable for long shipments, such as across the Atlantic—care should be taken not to remove the insects from the cold storage room at destination and to subject them suddenly to a much higher temperature. The mailing cases should be transferred from the cold storage room to thermos jars, in which they may be carried to the laboratory. They should be left in the thermos jars for about twenty-four hours, in which time they will gradually have come to the temperature of the laboratory. The temperature of the cold storage rooms on the ships used by the writer was said to be 38° F. The freshly parasitized eggs, packed as above, were sent by ordinary mail from Brownsville, Tex., to New York, where they were supposed to be placed in cold storage immediately by the steamship company. The several days during which they were on the road between Brownsville and New York gave the eggs time to turn black before being placed in cold storage.

Perhaps the most important point to be realized by an entomologist who undertakes to rear *Trichogramma* and other egg parasites is that such minute insects require special treatment because of their small size. The cages designed for them, the methods of feeding, shipping, etc., must all be considered with due regard to this factor.

Several entomologists of the writer's acquaintance are now engaged in work in connection with the control of certain injurious insects by the introduction or the artificial propagation of small hymenopterous parasites, and it is hoped that these and other workers may find some helpful suggestions in this article.

THE PERUVIAN FRUIT-FLY (ANASTREPHA PERUVIANA N. SP).

By Charles H. T. Townsend

Wormy fruits have long been known in the Peruvian coast region from Piura on the north to Lima and the southern provinces. The injury seems most acute during the month of February, at the time when the peaches, guavas, cherimoyas and other fruits are largely ripening. The fly is a general fruit pest, attacking not only deciduous fruits but citrus fruits as well. Peach and guava trees are often so completely infested that it is impossible to find a single sound fruit on the tree at times during February.

On February 17, 1912, the writer found in the Chira valley at Sullana, Peru, a guava tree in full fruit, bearing hundreds of beautiful large ripe fruits without a blemish so far as could be seen from the outside. Every fruit of many dozens opened contained trypetid maggots about the size of the Morelos orange-worm. Not an uninfested fruit could be found. The fly was seen on the fruits at that date. A number of these guavas were put in a box to rear the fly. Maggots began issuing from the fruits February 21, and flies issued from March 4 to 10. As indicating distinctness of generations in this fly, at least in this instance, it may be noted that on March 2, 1912, the same guava tree just referred to, having dropped the infested fruits of the preceding month and developed new fruits, showed on careful search only one infested fruit containing one small maggot, all the other numerous fruits being perfectly sound and uninfested.

As the species appears to be undescribed, a characterization of it is presented below. Its distinctness from *Anastrepha fratercula* Wd. may be seen by comparing the descriptions. It is, however, apparently rather closely allied to that species.

Anastrepha peruviana n. sp.

Length of female to end of ovipositor, 7 to 8 mm.; male, 6.5 to 7 mm.; wing, 6 to 6.5 mm.

Description of fresh specimens—Whole head, pleuræ, proximal half of venter and legs pale watery lemon-yellow; antennæ and proboscis with a buff-yellow tinge; tibiæ and tarsi appearing slightly dusky from the thick fine dark pubescence. Pleural plates, especially mesopleural and sternopleural, largely rufous-yellow tinged. Eyes bright green, shading to lilac-purple. About the same shade of light lemon-yellow or greenish-yellow as the occiput, face and front, or very slightly more deeply yellow and with an enameled effect, are the following:—Humeri; short pleural vitta stopping just before wing-base and confluent with humerus; lateral mesoscutal vitta behind transverse suture reaching scutellum; median mesoscutal vitta linear in front but suddenly widened behind, not reaching scutellum; and whole of scutellum; all these having an enameled faint greenish tinge. Rest of mesoscutum pale brownish-

rufous; metanotum same color, with a conspicuous deep brown or almost black wide lateral border showing like two vittæ; tergum of abdomen and ovipositor distinctly rufous-tinged but much lighter than mesoscutum, the hind edges of segments yellow in distinct fasciæ.

Wings marked with rufous-yellow and fuscous; a fuscous inverted V extending from third vein to hind margin of wing, its proximal arm enclosing the hind crossvein, just in front of which the arm becomes yellowish; fuscous and yellow band along costa from tip of apical cell to nearly opposite small crossvein, the color passing obliquely across wing over small crossvein to the narrowed and pointed tip of anal cell, thence diffused over most of basal half of wing leaving clear only the second basal cell, proximal end of discal, large area beyond middle of first basal, subtriangular area from distad of end of first vein to proximad of front end of small crossvein, two axillary lobes inside of anal cell, and less clearly the second costal cell; the color being largely yellowish narrowly edged with fuscous, the fuscous broadened in third posterior cell. First vein wholly spined, third vein spined to slightly or well beyond small crossvein. Apical cell narrowed by the fourth vein curving roundly costad just before reaching margin.

Abdomen of female wide and short, noticeably wider than long; ovipositor fully as long as abdomen, about three times as long as mean width, slightly narrowed posteriorly. Abdomen of male nearly twice as long as greatest width, gently narrowed posteriorly. Four bristles on scutellum, six on hind portion of mesoscutum, lateral ones on mesoscutum and pleuræ; five inwardly directed small bristles on parafrontals anteriorly, behind them two reclinate bristles beside the two vertical bristles on each side. Front of female hardly or nearly as wide as one eye, that of male slightly narrower, face widening evenly below from front.

Dried specimens are obscure tawny or pale dilute brownish on all except the enameled yellow portions, which last show as nearly white; while the abdomen is often distorted from its normal form as shown in the fresh specimens.

Type, female, collected at Chosica, Peru, 2,800 feet altitude, March 11, 1913. Description compared with dried specimens of both sexes reared from guavas collected at Sullana in the department of Piura, Peru, February 17, 1912, the flies having issued from March 4 to 10.

As a remedy for this fruit-fly the writer has advised a spray modeled after the Mally fruit-fly spray used in South Africa, applied to the foliage before the fruits begin to ripen or as soon as the presence of the flies is noted. The formula most convenient for use in Peru is lead arsenate 5 to 10 pounds, chancaca (brown or black cane sugar in cakes) 25 to 50 pounds, and water 100 gallons. The chancaca needs to be dissolved in boiling water before adding to the arsenate solution. The variation in the amount of arsenate is for regulation to different kinds of foliage, guava and orange standing much more than peach; while the sugar content should be increased in the same proportion with the arsenate.

A HISTORICAL ACCOUNT ON THE USE OF KEROSENE TO TRAP THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.)

By Henry H. P. Severin, Ph.D., *Honorary Fellow, University of Wisconsin,* and Harry C. Severin, M. A., *Professor of Entomology, South Dakota State College of Agriculture and Mechanic Arts*

The economic entomologist, owing to his vast field is compelled at times to recommend measures for the control of insects that are troublesome in his territory, even though he himself or his staff have not put these measures to a practical test. In not exactly rare instances, recommendations for the control of pests creep into text-books, station bulletins and entomological journals, and these measures even if followed out to the letter will be practically worthless in every locality where they are adopted. As an excellent illustration of a worthless recommendation for the control of a pest is the use of kerosene to trap the Mediterranean fruit fly.

Fig. 5. Self-feeding kerosene fountain for the capture of the Mediterranean fruit fly in Western Australia.

In this paper we shall first place before the reader the results of our experiments in attempting to control the Mediterranean fruit fly by means of kerosene traps and then we shall follow this with a historical account of this method of control as practiced or recommended in various parts of the world.

The attempt on our part to control the Mediterranean fruit fly by the use of kerosene traps wired to fruit trees was a complete failure. In one experiment 10 traps were wired in 10 fruit-bearing citrus trees located in different parts of an orchard and in five weeks, 10,239 fruit flies were captured; of this entire number, only 36 were females, the remainder being males. At the end of the five weeks nearly every ripe orange in this orchard had been "stung" by the pest. Trapping the Mediterranean fruit fly with kerosene was carried on for a period of eight months in the Hawaiian Islands in connection with other experiments and the results show that of every 1,000 fruit flies captured only three on an average were females, the remainder being males. After taking Weinland into the field and showing him the methods

which we employed in trapping the pest with kerosene, similar experiments were performed by this entomologist. Weinland (1912, p. 264) found that "the proportion of females to males caught is about 1 to 200." Howlett (1912, p. 413) in experimenting on the effect of oil of citronella on the Trypetid, *Dacus zonatus* Saund., found that of 18,000 specimens captured with this oil, "not more than 50 females were seen, or 0.3 per cent" of the total number of insects caught.

One would naturally suppose that the destruction of thousands of males in an orchard would soon lead to unfertilized females, for the opportunity that a female would have of copulating under such conditions would be greatly reduced. But whether or not a male will copulate more than once has not as yet been proven, nor has it been shown that the eggs of the fruit fly will or will not develop without fertilization. Furthermore, it is not to be inferred that all of the males in the immediate neighborhood of a kerosene trap are caught in a few days, for dozens of them may be captured week after week by sweeping among the leaves of the trees with an insect net. Dewar (1908, p. 3) frequently saw Mediterranean fruit flies around the tin containing the kerosene. Some of the flies would rest on the edge of the tin and later fly away without having touched the oil. "It seems clear that the oil caught only a certain percentage of the flies and that the others continued about the tree as usual." This is an observation which we can confirm.

Compere, chief quarantine inspector at San Francisco, has kindly given us the following account of the discovery that the Mediterranean fruit fly is attracted to kerosene. At Guilford, Australia, a farmer's wife had prepared some jam and because the ants were numerous around the house, she set the dish containing the jam on a hitching post to cool. To prevent the ants from crawling up to the jam, she daubed kerosene on the post. Towards evening, the daughter, a girl of eight years, noticed that the Mediterranean fruit flies were swarming around the post and she immediately called her mother's attention to this fact. It was thought at first that the fruit flies had been attracted to the jam, but after the father's attention had been called to the matter he investigated and found that the kerosene had attracted the pest. According to the Sydney *Morning Herald* (1907, p. 645) Devenish who made this discovery, caught 2,000 Mediterranean fruit flies in vessels containing kerosene, in the course of a week in his orchard. According to this account the credit of the discovery that kerosene attracts the Mediterranean fruit fly belongs in part at least to this youthful observer of nature.

In the further history of the use of kerosene to control the Mediterranean fruit fly in Australia, it will be seen that this new discovery

was not put under a severe experimental test by the entomologists before recommending and even forcing the people to use this method.

In Western Australia, Jefferson (1907, p. 162) was the first to report that "some good results have recently been obtained by using kerosene to attract and kill the flies."

During the same year, Compere and Newman (1907, p. 245) both of Western Australia, carried on an experiment with kerosene to trap the Mediterranean fruit fly. A vessel containing kerosene was placed in the forks of a tree and "18 hours later Newman removed and counted 124 fruit flies." No mention, however, was made of the percentage of male and female specimens taken. "*Female flies* removed from the oil showed upon examination to be fertile, being yet full of eggs." It was probably this last statement that influenced some entomologists to take it for granted that many female flies were attracted to the kerosene. This is shown through the interpretation of the above results by Quinn (1907, p. 12) of South Australia who writes as follows: "It is significant to note that many of these were females, containing large numbers of undeposited eggs, showing that the attractiveness of the kerosene took precedence over the instinct of egg deposition."

Hooper (1907, p. 696) also of Western Australia issued the following instructions in 1907, to all orchardists and those people who happened to have one or two trees, and these directions were to be enforced that year: "All fallen fruit throughout the orchard must be gathered daily, and all maggoty fruit destroyed by burning or boiling. In addition to these precautions, throughout the summer shallow vessels partly filled twice a week with kerosene must be placed one or more in each tree in the orchard, and shall be kept in or removed to such trees as an inspector may from time to time require."

In his "instructions to fruit growers" he also mentioned that "last season, in one orchard, 1,268 flies were destroyed by means of kerosene in 24 hours," but the ratio of males to females captured was not given.

Hooper (1909, p. 271) writes as follows concerning the results obtained by enforcing the fruit fly regulations during the preceding year: "This year we are very free of the fruit fly compared with previous years; this I put down principally to the compulsory use of kerosene last autumn, and the clearing up and destruction of maggoty fruit." In this same article he again recommends the use of kerosene to control the pest and enters into a discussion of the troubles experienced by the inspectors in compelling the fruit growers to hang tins of kerosene in the trees. He also states that "the trifling cost of kerosene and the little amount of extra labor are covered over and over again by the value of the fruit saved."

Newman (1910, p. 10) speaks very highly concerning the value of kerosene in controlling the pest: "The method of trapping the fly by the use of kerosene placed in bright, shallow, new tins, or better still in white saucers, has proved the most successful artificial method yet discovered and used in this state. . . . Large numbers of the flies have been captured by this simple means, and if consistently and universally used would cause a great reduction of the pest. *Large numbers* of the flies so caught have been examined and found to contain eggs." Newman now adds "large numbers" to his previous statement "female flies removed from the oil showed upon examination to be fertile, being yet full of eggs."

In New South Wales, Allen (1907, p. 546) experimented with kerosene to trap the Mediterranean fruit fly and says that the fly was "caught in quantities" but he fails to mention the number of males and females captured.

Gurney (1908, p. 581) and (1910, p. 425) also of New South Wales tried the kerosene method of controlling the Mediterranean fruit fly and writes, "As many as 200 adults have been captured in a couple of tins within three days." But like Allen he does not state the per cent of males and females captured.

A few South African entomologists also experimented with kerosene to trap the Mediterranean fruit fly and although some experimental work was carried on yet all of these entomologists overlooked the fact that the number of female flies captured in the oil form but a small per cent of the total number of flies caught.

Dewar (1908, p. 3) captured 444 fruit flies in 122 days in two tins containing kerosene, "one placed in, and the other under, a small citrus tree," but no mention was made of the ratio of males to females.

Mally (1908, pp. 3–5) tested the fondness of the fruit flies in captivity for kerosene and certain sweets. He liberated over 1,000 fruit flies in a cage containing two dishes of kerosene and "after six hours only 37 flies had been caught" but no mention was made of the number of males and females captured.

Lounsbury (1908, p. 6) kept a record of the number of fruit flies that he captured in kerosene and in two of the catches he stated the number of males and females removed from the trap. "On January 19 the first fruit fly, a male, was found in the oil; and in the week following three more were taken. Then from January 26 to February 6, five were taken. After that the catch became much better. Between February 6 and 11, 10 females and 12 males became victims. For the next 10 days the total was 19, and for the next week, 15; and from then, February 28 to March 17, the total was 30."

Ehrhorn (1912, p. 4), superintendent of entomology in the Hawaiian Islands, writes as follows concerning the number of male and female Mediterranean fruit flies captured in kerosene traps. "Among the various experiments tried against the fruit fly, the use of kerosene traps has shown that enormous quantities of male flies can be trapped by this method, but so far very few females have been captured." The results of our investigations with the use of kerosene to trap the Mediterranean fruit fly were read in Honolulu before the Agricultural Seminar on November 9, 1911, and January 11, 1912, at which this entomologist was present and yet Ehrhorn has published this result as well as other observations which we announced at these scientific meetings without due credit being given to our labors.

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THE EFFECT OF TIDES AND RAINFALL ON THE BREEDING OF SALT MARSH MOSQUITOES

By P. L. Buttrick, *New Haven, Conn.*

Early in the Spring of 1912 the Civic Federation of New Haven (Connecticut) raised funds for a campaign to control the mosquito nuisance which every summer for many years has given the city a distinction second only to certain places in New Jersey.

The chief species to be controlled was the banded salt marsh mosquito (*Culex sollicitans* Walk.). It was hoped to secure funds enough to ditch all the salt marshes within five miles of the center of the city, but as this was not done it was thought best to use some of the funds to oil areas which could not be drained, thus temporarily keeping down the numbers of the pest.

Early in June the writer was placed in charge of this work, as well as part of the ditching operations. The following is an amplification of part of his report to the New Haven Anti-Mosquito Committee, Inc., of the Civic Federation of New Haven, and is published with its consent. Acknowledgment is due the officials of the Engineer Corps, U. S. Army, stationed at New Haven, for permission to use government tide gage readings, and for many valuable suggestions.

The life history of the salt marsh mosquito was worked out some ten years ago by the late John B. Smith and his assistants. The eggs are laid singly on the salt marsh mud and lie dormant until covered by water, either tide or rain. They then hatch in a few hours; and in from six to fifteen days, according to the temperature, the pupae transform to adults. After hovering about the marsh grass for a day or two they migrate or are blown distances and invade summer resorts, country sides, and cities, making life miserable for the inhabitants. A few return to the marsh or remain in its vicinity and start the next generation.

The marshes where the salt marsh mosquitoes breed are usually flooded at certain periods when the tides rise above the general level, as usually occurs under the new moon. These are called the *perigee* tides. Consequently, shortly after this period, a brood of mosquitoes is liable to emerge. At other periods when the tides are high or when the marshes are flooded by rain other broods may be produced.

In an oiling campaign a knowledge of the time of the perigee tides is of the highest importance as it gives an opportunity for making preparations for controlling the brood following it. To determine this time, if possible, more accurately than can be done by calendar, a copy of the tide tables of the United States Coast and Geodetic Sur-

vey was obtained. These are published annually and predict for the year the time and heights of the tides for certain important harbors on the coasts of the United States. By simple calculations, the predictions can be extended to almost any point on the coast.

These predictions are obtained by methods of very great complexity which it is not necessary to discuss here. They are highly accurate as to time and reasonably so as to height. Their inaccuracies are due largely to meterological causes which can be predicted only approximately and for a short period in advance. The predictions themselves are based on variation of the astronomical phenomena which cause the tides.

The height of the maximum high tide at a given station for each day of the mosquito season may be plotted on cross section paper and a curve drawn connecting these points. If desired, a second curve may be plotted showing the height of the minimum high tides, for the two tides which occur daily seldom rise to the same height. If both high tides are plotted it will be seen that more regular curves are obtained by crossing the curves on dates when both tides rise to the same height which occurs about every fortnight. On the accompanying chart (figure 6) compare the 1912 and '13 prediction curves, where both tides are plotted with those for 1910 and '11, where only the maximums are given.

Such curves show a variation of nearly half the height of the highest tides, and also that there are more or less definite periods of extreme high tides followed by periods of low high tides. By plotting the phases of the moon on the same sheet, it may be seen that the periods of extreme high tides fall under the new and the full moon. These are called *spring* tides. The periods of low high tides fall under the moon's first and third quarter and are called *neap* tides. The period of highest high water is generally at the new moon and is called the *perigee* tide.

It should be understood that a curve of this kind does not show the daily fluctuation of the water level, only the predicted daily maximums. Curves showing the predicted daily rise and fall may easily be constructed but are of less value, since the discrepancy between the predicted and the actual height for a given day may be quite great, but when distributed over several days is reduced.

After plotting the high tide curves the next point is to determine at what height of tide a given marsh is flooded. There are three ways of obtaining this. First; by setting a tide gage at some convenient point on a stream or in the marsh. The records of this gage will establish a flood line below which the general surface of the marsh is not cov-

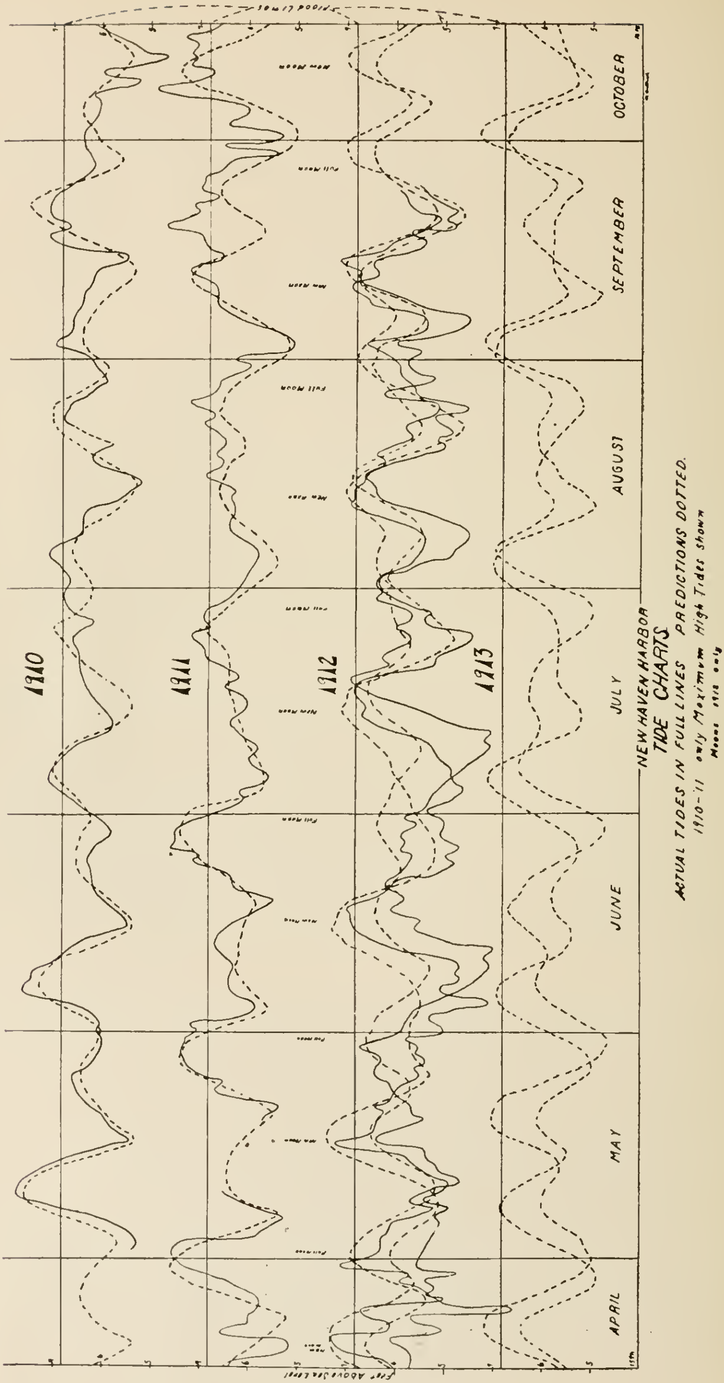
NEW HAVEN HARBOR
TIDE CHARTS
ACTUAL TIDES IN FULL LINES PREDICTIONS DOTTED.
1910-'11 only Maximum High Tides shown
Moons 1912 only
1910
1911
1912
1913
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
FEET ABOVE SEA LEVEL

Figure 6.

ered at high tide but above which it is. This method requires much time and is expensive but is the most accurate in the long run.

Second, to ascertain the general level of the marsh with reference to mean low water; this being the datum plane from which predictions are based. In order to do this it is necessary to use bench marks or points of known elevation with reference to sea level, and work from them. The United States Coast and Geodetic Survey, the United States Geological Survey, and the Engineer Corps, United States Army have each established bench marks along the coast which are supposed to be reckoned from mean low water, which is generally taken as mean sea level, but there may be some discrepancy and, before starting work from a given bench, it should be known that it is referred to the same datum plane as the predictions in the tide tables. Cities, towns, and railroads frequently have established bench marks which are conveniently located, but may be located with reference to high water or an assumed datum. If the correction factor is between them and the low water datum is known they may be used; otherwise, unless a line connecting them with a bench referred to mean low water is run, they are of no value.

By correspondence with the proper departments at Washington or by appealing to the proper local government officers these points can be determined. After establishing the bench mark a line of levels must be run from it to the marsh and the general level of the latter obtained within a tenth of a foot, as a tenth of a foot more or less in the height of the tide may determine whether or not a marsh will be covered sufficiently to flood the breeding pools. As entomologists are not generally also engineers it may be necessary to turn this work over to an engineer.

By adding a tenth or two of a foot to the marsh level it is possible to predict at what height of the tide it will be flooded. This for convenience may be called the *flood line*. The height of the flood line is not necessarily the height at which a marsh is entirely covered, simply that at which the breeding pools are filled and the grass breeding areas are flooded. In fact, at times the general level of the marsh may be scarcely covered, as the flooding of the breeding places may take place by seepage, leaving the higher parts uncovered. It may be that the height of the flood line will vary slightly from time to time according to the condition of the marsh which possibly acts as a sponge and does not always stand at precisely the same level. This matter would be a fruitful field for investigation.

The third method is to visit the marsh at high tide on different days and determine by observation at what height of tide they are flooded.

Observations at New Haven were made by combining the second and third methods.

By drawing a line across the tide chart at a height corresponding to the height of the flood line it can be seen at a glance when flooding will take place. Working charts used in the office also had the dates marked on the horizontal ordinate and the height in tenths of feet on the vertical ordinates at the beginning of each month. The moons were also plotted. The hour of each high tide might be entered in parenthesis after the proper point on the curve which for clearness is enclosed in a small circle. By exaggerating the vertical scale the differences in the height of the tide for different days are more clearly brought out.

The levels at which different local marshes about New Haven are flooded vary. At South End a tide of 6.5 feet floods some of the lower pools. Other marshes are not flooded until it rises over 7 feet; 6.8 feet seems an average and is used in the calculations for this report. The average rise in New Haven harbor is 6.2 feet, the maximum about 8 and the minimum about 4 feet. The accompanying chart shows the relation of the tides to the flood line for various years. From them we see that occasionally the full moon tides rise above the flood line, thus starting a brood of mosquitoes. It is also evident that the perigee tides may not always rise high enough to start a brood. If every perigee and full moon tide series flooded the marshes, the 6 months from April 15 to October,—the mosquito breeding season for this locality, there would be 12, 13, or 14 broods possible, depending upon the sequence of the moons. Probably this number is never realized. The maximum number shown by the curves so far plotted is 10. This number is indicated on the 1912 curve. The minimum so far shown is 7 for the 1911 curve. Eight is probably an average, curves for 7 years only being available.

With our present knowledge of the time it takes mosquitoes to develop, we can take the first day which a marsh is flooded in a series of high tides and add the approximate number of days necessary for their development and determine within a margin of a day or so when the adults will fly.

It should be understood that temperature conditions, early or late in the season, may be such that breeding is difficult, or impossible; that heavy rains may flood the marshes at other times, producing extra broods; or that winds and other causes may depress the tides and cut out a small brood or raise them when they are near the flood line so as to produce one not scheduled.

The following shows how the August campaign was laid out on a single marsh. On Saturday, August 10, 1912, the maximum high

tide was predicted, as will be seen from the curve, as 6.8 feet. This is sufficient to flood the West River Marshes. Development in ordinary August weather generally takes about one week; hence oiling, to be successful, must be done before the following Saturday night, or *August 17*. It will also be seen that the tides would continue to flood the marsh at least once daily till the end of the week so that oiling would have to be carried on with the tide still on the marsh.

Some idea of the accuracy of the predictions is obtained by comparing the predicted curves with actual tide gage readings plotted on the same sheet in the accompanying figure. Gage readings were obtained from Engineer Corps, U. S. Army, and were taken from tide gages in New Haven and Bridgeport harbors. The 1912 readings were taken from a gage in Bridgeport Harbor and correction factor figured mathematically. This probably accounts for some of the discrepancies. It will be seen that they are of sufficient accuracy to afford a reliable basis for planning an oiling campaign and if checked by gage readings from day to day would be of still greater value.

A given curve shows the periods of maximum high tides for an extended region, probably for all points within the same time belt, and would thus give a rough idea of the number of broods of mosquitoes to be expected in a given season over that territory; but for the actual heights and times of floodings a curve has only a local value. The territory over which it could be used for these purposes depending on the configuration of the coast line which determines the time and height of the tides locally. Thus, an open coast line which the tide wave strikes at right angles will have high water at approximately the same time for long stretches and it will rise to approximately the same height. On a broken coast line with bays, estuaries, fiords, etc., where the tide wave runs parallel to the shore, the time and height will vary greatly. At New Haven, where the tide wave runs parallel to the shore, a single curve only was used, but it is probable that better results would have been obtained if a separate one had been used for some of the outlying marshes. And it is certain that if the campaign had included Branford and Milford, points 10 miles east and west of New Haven harbor, respectively, that at least three curves would have been required.

The predictions are usually given for a certain point, a wharf head, breakwater, lighthouse, or the like. The salt marsh may be some miles away. If further up harbor, an addition sometimes as great as 2 hours must be made for the tide to reach that point. If down harbor, it does not necessarily follow that a deduction is required, as the resistance of the stream bed and marsh surface to the tide wave is great and even here the tide is apt to be at flood later than at the

point where the prediction is made. These points have to be worked out locally and are of chief importance as indicating when the marsh will be uncovered during periods of high tides, as work on them is easier and more effective at that time.

Although rainfall is a factor in the abundance of mosquitoes, it does not necessarily follow that the more rain the more mosquitoes. So far as salt marsh mosquitoes are concerned, the time and size of the individual rains are of great importance. A rain storm occurring when the tides almost reach the flood line may be sufficient to raise the water level so that a brood is produced. At another period when the tide level is low the same amount of rain might be carried off without its first covering the marsh. As near as we can judge at present, it takes a rainfall of at least an inch within 24 hours to start a brood of salt marsh mosquitoes, although rain in any amount, when larvæ are growing, will help to keep the pools from drying and increase the size of the brood. Rain may at times actually prevent breeding. A slight rain may cause the eggs to hatch but not provide water enough for their full development, thus effectually destroying them.

As is seen from the tables, after the first of June the rainfall at New Haven for 1912 was below normal as well as below the precipitation for 1911.

RAINFALL AT NEW HAVEN, CONN., DURING MOSQUITO SEASON.

(From United States Weather Bureau)

	NORMAL	1911	1912
April	3.56	4.31	4.56
May	3.64	0.74	6.34
June	3.17	2.73	0.50
July	4.78	2.17	2.14
August	4.99	5.57	3.22
September	3.79	2.33	2.32
October (1st to 15th)	1.83	2.12	.11

However, the rains in 1912 were largely at such times as to aggravate mosquito breeding. Starting with April, there were heavy rains about the 29th which increased the size of the second brood of the season. On May 16, at the height of the perigee of that month, it rained 2.85 inches. During June, not enough rain fell at any one time to affect breeding conditions. On July 21, just as the last of the July brood was emerging, we had nearly an inch of rain, which served to provide enough water to allow the fag end of the brood to

escape where oil had not been applied. From August 10 to 25, during the August perigee, 2.85 inches of rain fell, an amount ample to provide a brood on its own account. At the time of the first September brood it rained in all 0.95 of an inch, enough to materially increase the size of that brood. All in all, rain-fall conditions in 1912 decidedly favored an abundance of salt marsh mosquitoes about New Haven.

Investigations along the line of the relations of the tides and rainfall to breeding of salt marsh mosquitoes are far from complete, and offer an interesting opportunity for the investigator looking for a chance to increase our knowledge of the obscure physical causes which influence the varying abundance of life on our planet. Such an investigation would in the end pass out of the field of the entomologist into that of the engineer, or physiographer and the geologist, according as stress was laid on the tides or the marshes, but there is room for much more investigation on the purely entomological side.

NOTE ON THE FLOWERING AND FRUITBEARING OF YUCCA ALOIFOLIA IN SOUTH AUSTRALIA

By J. G. O. Tepper, *Norwood, South Australia*

Twenty years ago the writer contributed a short note to *Insect Life*, 1892 (Vol. IV, p. 74), when he first observed sound, but then still immature fruit at a distance from Adelaide of 30 miles; this struck me as singular on account of its dependence upon a highly specialized moth, endemic as well, in the American home. Excess of office work prevented me from investigating the problem personally as to the pollination of the Yucca in this state, there being no plants accessible to me, and the few other South Australian lepidopterologists were probably in a like fix, for nothing so far seems to have been done to discover the insect agent. However, a year or two later I acquired a young shoot of the fruiting species of Yucca, and planted it in my own back garden, where it prospered and grew, but did not flower for many years.

Three years ago, however, when the tree had attained a height over eight feet, it developed its virginal flower spike, but this set no fruit. Last year (1911), however, it produced two opposite branches near the crown, and both of these developed flower spikes, one a month in advance of the other. Of these, while the earlier one was in flower, but still bore buds, and the later only immature buds, I managed to take a photograph (Pl. 8, Fig. 1), December 22, 1911, of the crown with some difficulty. The older spike (right side) remained sterile, although

some of its late flowers were still open, when the younger one was in full flower a month or so later. The crown of the tree was now about 10 feet above the ground.

Ten fruits were developed by this younger spike and first noticed during February to March of this year (1912) although I am not aware of any other Yucca specimens existing within several hundred yards of mine. The flowers continued for from two to three months, and their shrivelled remains persisted much longer, while the fruits grew extremely slowly, attaining to proximate ripeness during October only. On the 3d of that month a photograph (Pl. 8, Fig. 2) was taken of the top of the tree, and in nearly the same direction as No. 1 (looking south) but from two feet distance with a portrait lens attached to the camera ("Brownie No. 2"), and showing the fruit from the north (*i. e.*, sunny) side. On the 9th, I cut out both spikes, and photographs were taken showing them from the reverse side (Pl. 8, Fig. 3). Some of the fruits were now soft and overripe, and one cut open a few days later was found too far gone for the detection of insect remains, the soft pulp being purple-veined. This fruit, one of the largest, contained 138 flat, black and perfectly ripe seeds and a much less number of small, thin, white ones, mostly located at and near the stalk end. The size of these varied from under three to over four inches and I remit two as samples for examination by experts[1] for external marks of insect agency, comparison with American fruits, etc., by separate parcel, and also a few of the peculiarly shaped seeds. These appear to me to resemble tick species in color and form, which may possibly assist in their distribution by birds feeding upon those animal parasites, and which, deceived by color and form, swallow them, and pass them softened with their excrement.

In Professor Riley's response appended to my note in 1892 (*Ins. Life*, IV, 74) reference is made to certain characteristics of the leaves being required for the determination of the species. The leaves of my tree are 20 to 23 inches long, $\frac{3}{4}$ to over $1\frac{1}{2}$ inches wide, very rigid and most acutely pointed, the upper side concave and smooth, the margins minutely rough-edged, forming crowded spirals near the crown. The older leaves bend backward and are finally closely adpressed to the trunk and long persistent when dry. The trunk of the tree is now fully six inches in diameter, and the total height, inclusive of the three branches, over ten feet.

Thus far then as my observations go, it took about 16 years in the

[1] Mr. August Busck, at the request of Dr. Howard, examined the specimens and found no evidence of insects. The specimens were very moldy and further comparisons were impracticable.—*Ed.*


3


2


1

Yucca Flowers and Fruit

locality before the first flowers were developed, but these without yielding fruit. The floral spike terminating the central axis of growth, two lateral opposite branches developed, but it took two years before the second set of flowers appeared, one spike being a month in advance of the other, and of which the earlier one also remained sterile while the later one produced a small number of fruits, that is, became pollenized by some agent adapted for that purpose, during January or February, the hottest summer months in South Australia. To complete the cycle of budding, flowering, fruit-setting and ripening it required about a full year, and likewise the cycle of the metamorphosis of the fertilizing insect from the egg, through the larval and (probably) pupal stages, passed within the slow growing fruits. Considering the absolute interdependence of plant and insect, the fruiting here, so far from their endemic home is very remarkable in this case, and appears to be explicable in two ways only, both equally problematical. The first is that *Pronuba yuccasella* larvæ were introduced with or imported with Yucca fruit to an Australian locality, where flowering Yucca trees existed when the imagines emerged from the pupal shell, in or near the fruits in which the eggs and larvæ developed.

The second alternative is, that an Australian insect exists possessing similar organs, *viz.*, prehensile maxillary appendages and long, extensible boring ovipositor, as the Pronuba, which has yet to be proved. I have not yet come across any evidence that either of the above alternatives has been investigated, and probably no person even lives now that could assist in proving the introduction theory.

EXPLANATION OF PLATE 8

1. *Yucca aloifolia* budding and flowering spikes, looking south, south west.
2. Ripe fruits, trunk 10 feet high, looking south.
3. Sterile and fruiting spikes, detached and shown from the reverse side as seen in figure 2.

FALL ARMY WORM

Laphygma frugiperda (S. & A.)

By J. A. Dew, *Field Entomologist, Auburn, Ala.*

The purpose of this paper is to set forth the facts in regard to the fall army worm which were determined during the outbreak last year. Owing to the fact that previously there has been little investigation concerning this species and because the worms are present in local areas again this year, it was thought best to give in condensed

form the results of the investigations and experiments conducted by the Alabama Experiment Station from May until December, 1912.

During the course of the work conducted last year, the following food plants of *L. frugiperda* were observed. They are arranged below in order of apparent preference by the larvæ: crab grass, Bermuda grass, blue grass, Johnson grass, corn in the bud, corn in the ear, sugar cane, bud and tender leaves, sorghum, millet, Kaffir corn, oats, wheat, cowpeas, sweet potatoes, velvet beans, soy beans, peanuts, string beans, cotton, Irish potatoes, bell pepper, turnips, rutabagas, pecan foliage, satsuma orange foliage, cockle burs, Alabama clover and briars (Solanaceæ). The only common plants observed upon which no larvæ were ever seen feeding were those of the Cucurbitaceæ family, watermelon, squash, pumpkin, etc.

Seasonal History.—The first appearance of adults recorded in Alabama was on May 4, 1912. This record was made in Mobile by Mr. H. P. Loding of that city. Following close upon the appearance of the moths, about May 15, came reports of ravages by the larvæ in the Mobile district particularly, and also from other South Alabama points. General pupation occurred from May 20 until June 1. The first week in June, however, brought an army of larvæ which wrought great destruction to the field crops. The life cycle was completed again during the next 30 days and in July the infestation was state wide. Two other generations were completed, one in August and one in September. By this time, through migration of the moths and attacks of natural enemies, the pest had practically disappeared from this state. Occasional larvæ were found in October and November. Specimens have been observed in hibernation in the larval, pupal, and adult stages, about 80 per cent appearing as pupæ.

Life History.—The detailed life history of *L. frugiperda* is very similar to that of some other members of the family Noctuidæ. As before suggested, the life cycle, under average summer temperatures, requires a period of some 30 days. The eggs are deposited by the female during the early part of the night (before 10 p. m.) in clusters containing from 60 to 500 eggs. These are usually placed upon the leaves of corn and cotton plants, blades of grass and other vegetation which will be suitable food for the young when they appear, but sometimes are to be found upon the leaves of pecan trees, orange trees and any forest trees which may be near the fields. The eggs may be deposited in two, three and sometimes four layers or decks when the cluster is especially large. After oviposition, the female covers the mass with a mouse colored down composed of silken threads and of scales from her body.

The eggs hatch in from two to four days, usually three days, depending upon the prevailing temperatures. The newly hatched larvæ make their first meal of the egg shells, avoiding the downy covering, and then lie close together for two or three hours, apparently resting and gaining strength before seeking other food. After the rest period a wholesale migration takes place, and the larvæ actively search in all directions for available food tender enough for their mastication. At this period of life their strength and ability to travel is remarkable, Mr. W. F. Turner having observed such larvæ to travel a distance of 15½ feet in one hour.

As soon as the young find suitable food, the general migration ceases and the larvæ settle down to feed upon the plant tissues, skeletonizing the tenderest foliage that is to be found. In about 24 hours the caterpillars cast their skins entering the second stage of their development, there being little difference except an increase in size. In another 36 hours the skin is cast again and now the marks which are typical of the full grown larva begin to appear faintly. In this third larval stage the specimens are about one half inch in length, are quite active and voracious feeders. The time spent in this stage is about 40 hours, the stripes and marks becoming more prominent before the skin is cast the third time. The fourth stage, lasting usually two and one half to three days is especially prominent because of the attainment of the typical marks and stripes of the full grown worm and the distinct appearance of the inverted "Y" in the face. There is scarcely any difference in appearance of larvæ of the fourth and fifth stages except in size and length. After casting their skin the fourth time, the larvæ attain a length of about seven eights of an inch.

During the fifth and sixth or last larval stage, the greatest damage is done. The worms are voracious feeders and appear to be unusually resistant to the effects of arsenical poisons. The fifth and sixth stages extend over a period of seven days when the larvæ, usually one and one fourth inches long, enter the soil near their food plant and form cells in which the transformation to pupæ takes place. In a stiff clay soil the pupal cells are usually three fourths of an inch long and lie at an angle one half inch below the surface. In loose sandy or loamy soils the cells are usually one inch long and are buried to a depth of one inch.

After the pupal cells are formed, the larvæ spin a weak cocoon composed of coarse silk binding together particles of soil. While the process of cell formation is going on, a gradual change takes place in the larva and at the end of 36 hours the pupa, varying from five eighths to three fourths of an inch in length, is complete, lying

in the cell. The time spent as pupa varies from three to sixteen days, the average being ten, and in the case of the specimens observed, the adult always emerged at night.

Mating, as a rule, takes place within the 36 hours following emergence and during the next 36 or 48 hours eggs are deposited for the next generation. The number of eggs deposited by one female varies from 160 to 700 with an average in the several cases observed of 450. These, as a general thing, are laid in two clusters, both during the same night, while a few scattering groups of four or five may be deposited the following night. The adults die in from four to eight days; the eggs hatch in from two to four days; the young larvæ begin their work of destruction and the life cycle is complete.

As determined in the insectary and checked by observations in the field, the life cycle was found to cover a period of 30 days when the mean temperature is 78°F. The time spent in the various stages of development is as follows: egg, three days; larval stage, 14 days; pupal stage, ten days, together with the three days necessary for mating and oviposition; total, 30 days. The figures given are the averages secured from the rearing of large numbers of individuals. Naturally there was a great variation, some specimens requiring 40 days while others completed the life cycle in 21. During the five months from May to September inclusive, there were five generations in the field, thus showing a field average of 30 days.

Observations made in the field during October and November showed 90 per cent of the eggs deposited during this time to be non-fertile. Larvæ collected in September and placed in breeding cages for further study were all destroyed by natural enemies, which by this time had become so numerous in the field that practically all specimens were parasitized. These two facts render inconclusive the evidence as to future generations, although occasional larvæ were found during these autumn months.

Natural Enemies.—Before the first generation of worms entered the soil in May for pupation, Tachinid flies and other parasites and predaceous enemies put in their appearance. While located at a temporary field laboratory at Irvington during August, 30 natural enemies were found preying on Laphygma. Of these, 21 were predaceous enemies and nine were parasitic. Of the predaceous enemies eleven were Coleoptera, four were Hemiptera and six Hymenoptera. The two most effective of the beetles were (*Tetracha carolina*) a tiger beetle and (*Calosoma calidum*), one of the ground beetles. The two most common of the true bugs which were preying upon the species belonged to the family Reduviidæ and have not as yet been determined. The solitary wasps were very effective in their work,

the two present in the largest numbers being *Polistes canadensis* and *Pelopœus cementarius*.

Nine true parasites were bred, four being Dipterous and five Hymenopterous. *Nemorea leucaniæ*, a Tachinid, and *Sarcophaga georgiana*, one of the Sarcophagidæ, were the most common of the Diptera. The parasitic wasps were of two families: Braconidæ and Ichneumonidæ, the most destructive species being *Eniscopilus purgatus*, a large yellow Ichneumon fly.

At various times during the season the following birds were observed feeding upon the worms, arranged in order of their effectiveness:—quail, field larks, common crow, mocking bird and English sparrows. Turkeys and chickens naturally fed on the worms near habitations. Early in the season small green tree frogs would secrete themselves in the bud of corn plants, capturing and feeding on unsuspecting moths which would be in hiding.

CONTROL —Two methods of artificial control were found to be effective, mechanical and arsenical. Nearly a hundred experiments were conducted during the year with varying results. From these experiments the following conclusions can be drawn.

First. A light shallow cultivation with either harrow or sweep during the period of pupation will turn up from 10 per cent to 50 per cent of the pupæ. Ordinary summer heat at the surface of the ground (120°F.) will kill the pupæ in 20 to 30 minutes.

Second. When the larvæ assume the army habit of travel, rolling with a heavy roller is ineffective except on hard ground. A heavy log, dragged up and down in a furrow, in the path of the advance is effective.

Third. Arsenical Control.—Arsenate of lead, powdered, used at the rate of 1½ pounds to 50 gallons of water was effective when applied to plants so that larvæ would reach it. Arsenite of zinc used at the rate of 1 pound to 50 gallons of water was also effective. When an "ortho" Arsenate of Lead was used, there was no injury to any of the food plants. Acid or 'meta" arsenates of lead gave burning in some cases unless lime was added. Arsenical control was obtained in young corn, only when the spray solution was forced into the bud. Dusting of the poisons was not effective except on plants having a broad lateral leaf surface as cotton, cowpeas, etc.

Poison bait was ineffective in the majority of cases. Early in the season when the fields were clean of grass and weeds and the larvæ spent the day in the soil, coming up at night to feed, the poison bran mash killed large numbers when placed at the base of young corn or cotton plants.

Fourth. Moths can be trapped at lights from dusk to 11 o'clock

p. m. About 50 per cent of those captured will have already deposited eggs.

Fifth. While in tropical and sub-tropical latitudes larvæ may be found all the year round, there is little doubt but that in this latitude the species winters as pupæ. Fall and early winter plowing, therefore, should reduce the number passing the winter successfully

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AN ANNOTATED LIST OF THE LITERATURE ON INSECTS AND DISEASE FOR THE YEAR 1912

By R. W. Doane, *Stanford University*

During the summer of 1911, Brues and Sheppard made careful studies of the insect life in the environment of recent cases of acute epidemic poliomyelitis. Their findings led them to believe that *Stomoxys calcitrans* might be concerned in the transmission of the disease. At one of the sessions of the Fifteenth International Congress on Hygiene and Demography September 26, 1912, Dr. Rosenau announced that six out of twelve monkeys exposed daily for several weeks to the bites of numbers of Stomoxys which had been allowed to feed on other monkeys that had been inoculated with poliomyelitis virus, became sick and showed symptoms of poliomyelitis. This announcement has created profound interest in all medical and entomological circles and has led to a long series of investigations by physicians and entomologists. In October, 1912, Anderson and Frost of the United States Public Health Service repeated these experiments and their results seemed to confirm the findings announced by Rosenau. The results of no other experiments have yet been announced and it remains to be shown whether this is a usual method of transmission in nature. References to only a few of the most important of the many articles and comments on this subject are given in the following list.

The Simuliidæ, too, have continued to receive a great deal of attention on account of their possible relation to pellagra. Forbes, Hunter and Garman have made detailed studies of the Simuliidæ of Illinois, Kansas and Kentucky respectively and while they find much in support of Sambon's theory, the fact that these flies are really the carriers of the virus that causes the disease has been by no means proven.

A small outbreak of plague in Cuba again awakened the people, particularly on the Gulf and Atlantic Coast, to the necessity of keeping the seaport towns as free as possible from rats.

The name of another martyr to scientific medicine was added to

the list when Dr. T. B. McClintic of the United States Public Health Service died in Washington after having contracted Rocky Mountain spotted fever while investigating the disease in Montana. Dr. McClintic was regarded as the leading authority on this disease.

A man better known to all entomologists was Prof. J. B. Smith, who died in New Brunswick in March, 1912. His work in nearly all the fields of applied entomology, and his long list of important publications, caused him to rank as one of the very foremost of American entomologists. Within recent years his work on mosquitoes and mosquito control has been of particular interest and importance.

Among the many articles on malaria and mosquitoes one or two deserve special notice. A. J. Orenstein gives an instructive article entitled "Sanitary Inspection of the Canal Zone" in Amer. Jour. Pub. Health, Vol. II, March, 1912, in which he describes the successful fight being made there against malaria, yellow fever, plague and typhoid. Much interest has been taken in the experiments first successfully carried out by Drs. Bass and Johns, wherein *Plasmodium vivax* and *P. falciparum* were grown in cultures through one or more generations.

Considerable attention has been paid to the possibilities of flies carrying bacteria. Dr. J. C. Torry, in Jour. Infec. Dis. March, 1912, shows that as many as 4,400,000 organisms may occur on the outer surface of the fly and that 28,000,000 may be found in the intestine. From 13 per cent to 37 per cent of these were found to be fecal bacteria. Cox, Lissant, Lewis and Glynn report that flies in insanitary city areas may contain 800,000 to 500,000,000 bacteria per fly. Tebbutt concludes that the possibility of flies becoming infected from the presence of pathogenic organisms in the breeding ground of the larvæ may be considered as very remote. In another series of observations Hewitt finds that 700 yards was the greatest distance that houseflies flew from the places where they were marked.

The principal interest in the study of the sleeping sickness situation has centered around the papers by Kinghorn and York, Stevens and Fantham and others who believe that *Trypanosoma rhodesiense* is distinct from *T. gambiense* and that *Glossina morsitans* is the carrier. This of course greatly complicates the problem of controlling this disease, as *G. morsitans* has a much wider range than *G. palpalis.*

In July, 1912, the Tropical Disease Bureau ceased to publish the Sleeping Sickness Bulletins and in November began the publication of the Tropical Diseases Bulletin which will include reviews of literature on other diseases as well as of Sleeping Sickness.

Once more I wish to point out that the following list makes no claim to completeness. It includes references (with a few exceptions)

only to American and English journals, most of which are available to many physicians and entomologists. An attempt to include even the most important of the continental papers would extend too greatly the scope of this article.

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mosquitoes and mosquito larvæ found in New Jersey. Ent. News, Vol. XXIV, No. 2, February, 1913, pp. 65–72. Tables for determining adults and larvæ.

Wise, K. S. and Minnett, E. P. Experiments with crude carbolic acid as a larvicide in British Guiana. Ann. Trop. Med. & Par. Vol. 6, No. 3, B. October 18, 1912. pp. 327–330. Found paraffine and petroleum useless because they blow to one side, must use a soluble form of larvicide. Crude carbolic, a teaspoonful to every 2 cubic feet of water or one oz. to 16 cu. ft. is recommended.

Wise, K. S. and Minnett, E. P. Experiments with crude phenol as larvicide in British Guiana. Ann. Trop. Med. & Par. VI, No. 3, October 18, 1912. Crude phenol, 1 to 20,000, kills all larvæ but not pupæ in 2 hours, becomes more concentrated as pool dries up and may impregnate the ground so that the water that collects there later will be unfit for mosquito larvæ.

Malaria

Bass, C. C. and Johns, F. M. The cultivation of malaria plasmodia (*P. vivax* and *P. falciparum*) in vitro. Jour. Ex. Med. XVI, No. 4, October, 1912. These species grown in cultures through one or more generations. Sexual cycle not grown. Reviews and notes on these experiments occur in Jour. Ann. Med. Assn. September 21, October 12, 1912. In the N. Y. Med. Times, June, 1912 and in many other places.

Carter, Henry R. Anti-malarial measures for farmhouses and plantations. Pub. Health Rpts. Vol. 27, No. 49, December 6, 1912, pp. 2024–2030. Emphasizes the importance of controlling the human and insect host.

Celli, A. Reduction of malaria in Italy. Policlinico, Rome. Government distributes quinine practically gratuitously. By this and other means excellent results secured.

Christophers, S. R. Malaria in the Andamans. Sci. Mem. by Officers of Med. & San. Dpts. Govt. India. New ser. No. 56, 1912. A consideration of the carriers in this region.

Fermi, C. L. and Lumbau, S. Können Anopheles-Mücken auf den Menschen Malaria übertragen, ohne sich durch Besuch von Malariakranken verseucht zu haben? Können dieselben sich die Infektion aus anderen Tieren als dem Menschen holen? Centralbl. f. Bakt. 1 Abt. Orig. 1912, July 3, Vol. 65, No. 1–3, pp. 105–112. Conclusions: Anophelines which have not fed on malarial patients cannot infect man; feeding on infected birds or animals other than man, does not make them infective for man.

Gray, Harold Farnsworth. Malarial control in California. Amer. Jour. Pub. Health, Vol. II, No. 6, 1912, pp. 452–455. Record of the work since 1910.

Stammers, Major and Davys, Capt. Apyrexial malaria carriers. Jour. Roy. Army Med. Corps Vol. XVIII, No. 3, March, 1912. Some people may carry the malarial parasites without showing signs of the fever.

Stryke, A. C. The life-cycle of the malarial parasite. Ento. News, Vol. XXIII, No. 5, May, 1912, pp. 221–223. Diagram to show development of parasite in man and mosquito.

Thompson, J. G. and McLellan, S. W. Note by Ross. The cultivation of one generation of malarial parasites (*Plasmodium falciparum*) in vitro, by Bass's method. Ann. Trop. Med. & Par. Vol. 6, No. 4, December 30, 1912. pp. 449–459.

Yellow Fever

Agramonte, A. The so-called parasite of Yellow fever. Med. Rec. March 30, 1912, annotation in Jour. Trop. Med. & Hyg. May, 1912, pp. 136–137. Criticism

of Seidelin's article in Yellow Fever Bull. Doubts whether the bodies Seidelin found are parasites.

Guiteras, Juan. A false alarm of yellow fever (Cuba) and how it was met by Health Department. Amer. Jour. Pub. Health, Vol. II, March, 1912. pp. 170–173. Buildings where suspected cases were found were covered with canvas and fumigated with sulphur.

Liceaga, Eduardo. Annual report on yellow fever in the Mexican Republic. Amer. Jour. Pub. Health, 1912, Vol. II, No. 3, pp. 174–181. Cites a case that he believes does not come within the generally accepted theory of mosquito transmission.

Seidelin, Harald. Yellow fever prophylaxis. Yel. Fev. Bur. Bull. Vol. I, No. 10, February, 1912. Abstract in Jour. Trop. Med. & Hyg. XV, May 1, 1912. Discusses various prophylactic measures but concludes that mosquito destruction is the only radical measure.

Seidelin, Harald. Report of yellow fever expedition to Yucatan 1911–12. Yel. Fev. Bur. Bul. Vol. II, No. 2, October, 1912, pp. 123–124. Contains notes on Stegomyia and its importance.

Theobald, F. V. The distribution of the yellow fever mosquito and general notes on its bionomics. Int. Ent. Cong. II, pp. 145–170.

Yellow fever epidemiology. Yel. Fev. Bul. Vol. I, No. 9, June, 1912, pp. 291–293. Several recent isolated outbreaks are inexplicable according to our present actual knowledge. The suggestion has been made that the germs may be found in some other animals, but absolutely nothing to support such a theory.

The outbreak of yellow fever in Yucatan. Yel. Fev. Bul. Vol. I, No. 10, February, 1912, pp. 335–337. Discusses the probable origin of this outbreak.

Yellow fever in 1912. Yel. Fev. Bur. Bull. Vol. II, No. 2, October, 1912. pp. 121–122. Notes on reported cases.

Filariasis

Bahr, P. H. Filariasis in Fiji. Jour. Trop. Med. & Hyg. Vol. XV, March 1, 1912, pp. 77–79. Report on a paper read before the Soc. Trop. Med. & Hyg. January, 1912. Cause of the disease, effect on the patient and means of transmission and control.

Bancroft, Thos. L. The prevention of filariasis. Australasian Med. Gaz. January 27, 1912, Vol. XXXI, No. 4. Annotation in Jour. Trop. Med. & Hyg. Vol. XV, March 15, pp.92–93. Prophylactic measures recommended. Destroy breeding places of *C. fatigans.*

Low, Geo. C. The life of filarial embryos outside the body. Jour. Trop. Med. & Hyg. Vol. 15, No. 22, November 15, 1912, pp. 338–339.

Leprosy

Cantle, J. Our knowledge of leprosy. Jour. Trop. Med. & Hyg. Vol. XV, March 1, 1912, pp. 74–77. Notes on the attention that is being paid to this disease, the possibility of its being transmitted in various ways.

Currie, D. H. and Hollmann, H. T. Further observations on rat leprosy. Pub. Health Bull. 50, 1912. Further evidence that the mites infecting rats may be responsible for transmitting this disease but no positive evidence that this is the case.

Foulerton, A. G. R. As to the nature of the parasites of leprosy and tuberculosis. Brit. Med. Jour. February 10, 1912, p. 300. Believes that the causative

agent is not a bacillus but a *Streptothrix* and called *S. lepræ*. (This belongs to a group placed by Hiss & Zinsser among the "higher bacteria." It has branching threads or mycelia and produces spores, hence, it would seem, is more liable to be transmitted by insects than if it were a true bacillus.)

Long, Edward C. A note on the transmission of leprosy. Jour. Trop. Med. & Hyg. March 1, 1912, from Med. Rep. fr. Basutoland, 1910. Experiments seem to show that bedbugs biting leprous patients contain the *Bacillus lepræ* and that they may transmit them.

Our present knowledge of leprosy. Leading article in Brit. Med. Jour. June 29, 1912. Recent studies seem to show that causative organism may not be a bacillus as it has a more complicated life history. Many experiments seem to indicate that it may be transmitted by some insect such as house flies, biting flies, mosquitoes, fleas, lice, bugs, mites, ticks, and bedbugs being particularly suspected.

Housefly

Britton, W. E. The housefly as a disease carrier and how controlled. Pub. by Conn. Sta. Bd. of Health, 1912. Life history and habits. Methods of control.

Britton, W. E. The role of the housefly and certain other insects in the spread of human diseases. Pop. Sci. Mo., July, 1912. Tells how disease may be transmitted by insects and discusses flies, mosquitoes, fleas etc.

Britton, W. E. The housefly and its relation to typhoid fever. Proc. Sixth San. Conf. Hl. Of. of Conn. April, 1912, pp. 18. (Hartford.)

Cox, G. Lissant, Lewis, F. C. and Glynn, E. E. The number and varieties of bacteria carried by the common housefly in sanitary and insanitary city areas. Jour. Hyg. Vol. 12, No. 3, October, 1912, pp. 290–312. Finds that the flies in insanitary areas contain many more bacteria, 800,000 to 500,000,000 per fly. Methods used in making the experiments, a review of previous experiments and a list of references are given.

Graham-Smith, G. S. Houseflies. Bedrock, No. 2, July 1912, pp. 205–223. Refers to the time when bedbugs were very common pests in many places and suggests that our descendants may look with as much surprise upon our tolerance of flies. Interesting notes on the methods of feeding and infection experiments. Shows that various bacteria including disease-producing germs may be found on the body and in the intestine from two to ten days or more.

Hewitt, C. Gordon. Observations on the range of flight of flies. Rep. Local Gvt. Bd. Pub. Health & Med. Sub. 1912 (n. s. No. 66), pp. 1–14. Experiments to show how far flies may fly from their breeding grounds. Seven hundred yards was the greatest range in these experiments.

Hodge, C. F. A new fly trap. Jour. Econ. Ent. Vol. 6, No. 1, February, 1913. pp. 110–112. Description of a large trap that has proved successful.

Lumsden, L. L. The causation and prevention of typhoid fever. Pub. Health. & Mar. Hos. Ser. Bul. 51, 1912. Discusses among other sources of danger the insanitary privies.

Nicholls, Lucius. Transmission of pathogenic micro-organisms by flies in Saint Lucia. Bul. Ent. Res. Vol. III, pt. 1, May, 1912, pp. 81–88. Experiments with flies breeding in human excrement, how some of them may carry germs from man to man directly or through his food.

Paine, J. H. The housefly in its relation to city garbage. Psyche, Vol. XIX, No. 5, October, 1912, pp. 156–159. More than 22 per cent of the swarms of flies that breed in garbage cans are house flies.

Richardson, C. H. An undescribed hymenopterous parasite of the housefly.

Psyche, Vol. XX, No. 1, February, 1913, pp. 38–40. Description and notes on a parasite reared from housefly pupæ.

Stallman, G. P. Ants destroying larvæ of flies. Mil. Surg. 31, No. 3, September, 1912.

Tebbutt, Hamilton. On the influence of the metamorphosis of *Musca domestica* upon bacteria administered in the larva stage. Jour. Hyg. Vol. 12, No. 4, December, 1912. pp. 516–526. Concludes that "The possibility of flies becoming infected from the presence of pathogenic organisms in the breeding ground of the larvæ may be considered as very remote."

Terry, C. E. Extermination of the housefly in cities, its necessity and possibility. Amer. Jour. Pub. Health, Vol. II, January, 1912, pp. 14–22. Danger in cities without good sewage systems. Ground floors of stable stalls often worst breeding places, sometimes two or more inches deep. Eggs and larvæ under 14, 26, 36, 41 and 48 inches sterilized sand produced flies which harbored bacteria with which the food of the larvæ was infected.

Thompson, F. W. Housefly as carrier of typhoid infection. Jour. Trop. Med. & Hyg. XV, No. 18, September 16, 1912.

Torrey, Jno. C. Bacteria and flies. Jour. Infec. Dis. March, 1912. The fly as an agent in the spread of disease. Four hundred and seventy to 4,400,000 organisms on surface of fly, 16,000 to 28,000,000 organisms in intestine. Some of these were fecal bacteria of the colon type; 13.1 per cent on the surface, 37.5 per cent in the intestine.

Torrey, J. C. Numbers and types of bacteria carried by city flies. Jour. Infec. Dis., 10 (1912), No. 2, pp. 166–177. Record of numbers and kinds of bacteria found.

Washburn, F. L. The Minnesota fly trap. Circ. No. 24, August 12, 1912, State Ento. Minn. Description of this trap in which bread and milk was used for bait. (See also Jour. Eco. Ento. V, October, 1912, and Sci. N. S. 36, October 18, 1912.)

How to make a flyless town. World's Work, 24: June, 1912, pp. 176–179. Things necessary in a successful fly campaign.

The fly and the surface privy. Comment in Cal. Sta. Bd. Health. Vol. 7, May 1912, pp. 228–229. The danger from this source.

Transmission of *Trypanosoma hippicum* by the housefly. Rep. Dept. Sanit. Isthmian Canal Com. 1912, April, p. 41.

Myiasis

Austen, Ernest E. British flies which cause myiasis in man. Rept. Loc. Gov., Bd. Pub. Health & Med. Sub. (n. s. No. 66) 1912, pp. 5–14. Notes on ten or more species. Bibliography.

Busck, A. On the rearing of a *Dermatobia hominis*. Proc. Ent. Soc. Wash. 14 (1912) No. 1, pp. 9–13. Records the breeding of this fly in human host.

Cockayne, Intestinal myiasis. Lancet, January 20, 1912. Larvæ of *M. domestica* and *Fannia* (*Homalomyia*) *canicularis* found in bed where child slept.

Hewitt, C. G. *Fannia* (*Homalomyia*) *canicularis* and *F. scalaris*. Paras. 5 (1912) No. 3, pp. 161–174. Bionomics of these flies and their relation to myiasis.

Hewitt, C. Gordon. An account of the bionomics and the larvæ of the flies *Fannia* (*Homalomyia*) *canicularis* L. and *F. scalaris* Fab. and their relation to myiasis of the intestinal and urinary tracts. Rep. Loc. Gvt. Bd. Pub. Health & Med. Sub. (n. s. No. 66) 1912, pp. 15–22, same in Parasit. V, No. 3, September, 1912. Gives reason for change of generic name. Descriptions of the stages of the two species and

notes on their habits. Often found in alimentary canal and sometimes in urinary tract. References to literature.

Knab, Frederick. The habits of flies of the genus *Cordylobia*, parasitic on man in Africa. Sci. N. S. XXXV, April 26, 1912. p. 662 Review of an article by Roubaud in Compt. Rendus Hebdom. des Seances de l'Acad. des Sci. October 23, 1911. The larvæ of *C. anthropophaga* found under skin of man and domestic animals, larvæ hatch in sand or elsewhere and later penetrate their host. Natives who sleep on the ground more apt to be infected. Another observation by von Pelser-Berensberg (Soc. Entomol. Vol. 26, p. 34, July 29, 1911) on *C. rodhaini* showed that these flies laid their eggs on his underclothing while he was bathing. The larvæ hatched and penetrated the skin.

Singleton. *Dermatobia noxialis* infection in man. Jour. Amer. Med. Assn. April 27, 1912. A larva called *ver macaque* occurring under skin of a man.

Pellagra

Forbes, Stephen A. On black flies and buffalo-gnats (*Simulium*) as possible carriers of pellagra in Illinois. 27th. Rep. Sta. Entom. of Ill., pp. 21–52. (1912.) Habits and life history of the group; description of Illinois species. possible relation to pellagra; no definite data.

Garman, H. A preliminary study of Kentucky localities in which pellagra is prevalent. Kentucky Agric. Ex. Sta. Bull. 159, January, 1912. The following facts were observed which indicate that the disease might be insect-borne; eruptions in the cases noted, first appeared on the hands, arms, neck or legs, portions of the body exposed to insect bites. The disease becomes most prevalent just after Simulium appear in greatest numbers. It often attacks children who go bare-footed and bare-legged and who wash in streams. List of insects and other animals studied. A summary of Dr. Sambon's findings.

Hunter, S. J. Sand-fly and pellagra. Jour. Amer. Med. Assn. LVIII, February 24, 1912. Discusses theories as to cause, particularly Sambon's theory and records experiments, not yet completed, to test this theory.

Hunter, S. J. Pellagra and the sand-fly, II. Jour. Econ. Ent. Vol. 6 No. 1, February, 1913, pp. 96–101. Notes on the distribution and life history of these flies in Kansas. Investigators have not been able to inoculate monkeys with this disease. Some of their findings seem to favor Sambon's theory, but anything like definite proof is still lacking.

Lavinder, C. H. A report of the second triennial meeting for the study of pellagra, held at Columbia, S. C. October 3–4, 1912. Pub. Health Rpts. Vol. 27, No. 44, November 1, 1912, pp. 1776–1778. Notes on papers presented. In one of these Jennings and King suggested that Stomoxys may possibly act as a carrier.

Nicholls, Lucius. Pellagra: "Sand-fly Protozoon" versus "maize "theory. Jour. Trop. Med. & Hyg. Vol. 15, No. 20, October 15, 1912. pp. 305–306. Author not an ardent supporter of either the maize or Sambon's theory of infection.

Ormsby, Oliver S. (Med. Secty. Ill. Pellagra Comm.) Jour. Cutaneous Dis. Vol. 30, No. 10, October, 1912, pp. 589–607. Believe that the disease is due to infection with some living micro-organism, possibly in the alimentary canal of man. They found but little to support Sambon's theory.

Ravitch, M. L. A plea for an earlier diagnosis of pellagra. Jour. Amer. Med. Assn. Vol. LIX, July, 6, 1912, pp. 33–35. Discusses causes and transmitting agents. Believes that corn theory is most plausible. Does not believe that Sambon's theory in regard to the sand-fly or that Garman's theory in regard to the buffalo-gnat can be proved.

Roberts, Stewart R. Pellagra,—history, distribution, diagnosis, prognosis, treatment, etiology. C. V. Mosby Co. St. Louis, 1912.

Literature on pellagra and hookworm. Jour. Amer. Med. Assn. Vol 59, No. 13, September 28, 1912, p. 1205. A list of recent books and papers on these subjects.

Phlebotomus or Sand-fly Fever

Robinson, S. C. B. and Blackham, R. J. Sand-flies and sand-fly fever on the North-West frontier of India. Jour. Roy. Army Med. Corps, Vol. 19, No. 14, October, 1912, pp. 447–452. Includes notes on *Phlebotomus*; the flies are sometimes so numerous as to make evacuation of barracks necessary.

Seidelin, Harald. Pappataci fever. Yel. Fev. Bur. Bul. Vol. II, No. 1, July, 1912, pp. 74–84. A full discussion of this disease and the fly (*Phlebotomus pappatacii*) which transmits it.

Pappataci fever. An. Rep. San. Com. with Gov. India, 1910–12, pp. 59 and 25. Includes an account of life history of *Phlebotomus*.

Poliomyelitis

Anderson, John F. Transmission of poliomyelitis by means of the stable fly (*Stomoxys calcitrans*). Pub. Health Rep. Vol. 27, No. 43, October 25, 1912, pp. 1733–1735. Stomoxys allowed to bite infected monkeys and then transferred to uninfected monkeys which later died of the disease. These experiments confirm those made by Rosenau.

Bishopp, F. C. The stable fly (*Stomoxys calcitrans*) an important livestock pest. Jour. Econ. Ent. Vol. 6, No. 1, February 19, 1913, pp. 112–126. Importance of the pest, life history and habits and methods of control.

Bouet, G. & Roubaud, E. Expériences de Transmission des Trypanosomiasis animales de l'Afrique Occidentale française, par les Stomoxes. Bul. de la Soc. Path. Exot. Jouillet V. No. 7, 1912, pp. 544–550. It is demonstrated that certain trypanosomes, particularly those of surra, are transmitted by *Stomoxys*.

Brain, C. K. *Stomoxys calcitrans* Linn. Annals Ento. Soc. Amer. Vol. 5, No. 4, December, 1912. pp. 421–430. Compares *M. domestica*, *H. canicularis*, and *S. calcitrans* and gives notes on structure and feeding habits of the latter.

Brues, C. T. and Sheppard, P. A. E. The possible etiological relation of certain biting insects to the spread of infantile paralysis. Jour. Econ. Ento. Vol. 5, August, 1912, pp. 305–324. Data which suggests that insects may be the carriers. Table of diseases that are insect-borne, record of investigations.

Flexner, S. Infantile paralysis: Problems in infection and its control. Sci. n. s. 36, November 22, 1912, pp. 685–702. A discussion of the progress made in the study of this disease.

Frost, Wade H. Notes on the discussion of poliomyelitis at the fifteenth international Congress of Hygiene and Demography. Pub. Health Rpts. Vol. 27, No. 41, October 11, 1912, pp. 1661–1664. Includes brief review of Rosenau's findings.

Howard, C. W. and Clark, P. F. Experiments on insect transmission of the virus of poliomyelitis. Jour. Exp. Med. Lancaster, Pa. 16, No. 6, December, 1912.

Richardson, Mark W. Recent contributions to our knowledge concerning infantile paralysis. Amer. Jour. Pub. Health, Vol. 2, No. 3, 1912, pp. 141–144. Review of some recent observations and experiments.

Rosenau, M. J. and Brues, C. T. Some experimental observations upon monkeys concerning the transmission of poliomyelitis through the agency of *Stomoxys calcitrans*, a preliminary note. Psyche, Vol. XIX, No. 6, December 1912, pp. 191–194. Gives reasons for suspecting these flies and records the experiments by which

they apparently transmitted the virus of poliomyelitis from monkey to monkey. (See also Jour. Amer. Med. Assn. October 12, 1912, November 2, 1912, Pub. Health Rpts. September 27, 1912 and several places for comment and reviews of the experiments.

Poliomyelitis (infantile paralysis). Pub. Health Rpts. Vol. 27, No. 35, August 30, 1912, pp. 1412–1413. A summary of the outbreaks in United States during the past few months.

Poliomyelitis. Bulletin for information of health officials. Cal. St. Bd. of Health October 15, 1912. Summaries of the theories in regard to this disease and suggests measures for control.

Other Flies

Cleland, J. B. Memorandum on surra. Sec. Rep. Gov. Bur. Microbiol. N. S. Wales, September, 1912, pp. 71–72. Notes the presence of *Stomoxys calcitrans* which is regarded as the transmitter of surra.

Cragg, F. W. Studies on the mouthparts and sucking apparatus of the blood-sucking Diptera, (No. 1 *Philæmatomyia insignis*). Sci. Mem. Govt. India, No. 54, 1912. Structure of the mouth parts of this fly which is closely related to *Musca*.

Cragg, F. W. The structure of *Hæmetopota pluvialis*. Sci. Mem. Govt. India, No. 55, 1912. A good discussion of the external and internal anatomy of this Tabanid.

Knab, Frederick. Blood-sucking and supposedly blood-sucking Leptidæ. Proc. Ent. Soc. of Wash. Vol. 14, No. 2, April–June, 1912, pp. 108–110. Some species of Leptidæ that bite man and animals. Discussion of other species.

Knab, F. and Cooley, R. A. Symphoromyia as a blood-sucker. Proc. Ent. Soc. Wash. 14, 3, September, 1912, p. 161. Notes on this Leptid which Professor Cooley found biting in Montana.

Leese, A. S. Biting flies and surra. Jour. Trop. Vet. Sci. 1912, January 7, No. 1, pp. 19–32. Believes that mechanical transmission is the usual way in which these flies transmit this disease. *Lyperosia*, *Stomoxys* and *Tabanidæ* may be concerned.

Trypanosomes, Tsetse Flies and Sleeping Sickness

Blacklock, B. The vitality of and changes undergone by Trypanosomes in the cadaver of the animal host. Ann. Trop. Med. & Par. VI. No. 1 B. May, 1912, pp. 55–68. (Abs. in S.S. Bull. 38, p. 125.) *T. gambiense* and *T. rhodesiense* can remain infective in the blood of a dead animal host for 48 hours.

Carpenter, G. D. H. Progress report on investigations into the bionomics of *Glossina palpalis*, July 27, 1910 to August 5, 1911. Rep. of Sl. Sickn. Com. of Roy. Soc. No. 12, 1912, pp. 79–111.

Darling, S. T. Experimental infection of the mule with *Trypanosoma hippicum* by means of *Musca domestica*. Jour. Exp. Med., 15 (1912), No. 4, pp. 365–366.

Duke, H. L. Antelope and their relation to Trypanosomiasis. Proc. Roy. Soc. ser. B. Vol. 85, May, 1912, pp. 156–169. (No. B 577.) Antelope act as reservoirs for *T. gambiense*.

Fell, T. E. Notes on tsetse flies and on prophylactic measures against sleeping sickness in the western province of Ashanti. Bull. Ent. Res. Vol. 3, pt. 3, November, 1912, pp. 227–231.

Fraser, A. D. and Duke, H. L. The relation of wild animals to Trypanosomiasis. Proc. Roy. Soc. March, 1912, B. 85 No. B 576. *T. uniformæ* was the only trypanosome obtained from wild animals as a result of this study.

Jack, Rupert W. Observations on the breeding haunts of *Glossina morsitans*. Bul. Ent. Res. Vol. II, pt. 4, January, 1912, pp. 357–361. Records finding of pupæ.

KINGHORN, ALLAN. Notes on the preliminary stages of *Glossina morsitans* Westw. Bul. Ent. Res. Vol. 2, pt. 4, January, 1912, pp. 291–296. Description of larva and pupa.

KINGHORN, ALLAN AND YORKE, WARRINGTON. On the transmission of human trypanosomes by *Glossina morsitans* Westw.; and on the occurrence of human trypanosomes in game. Amer. Trop. Med. & Par. 1912, March 2, No. 1, A. pp. 1–23. Conclude that the human trypanosomes in some regions are transmitted by *G. morsitans*. They may become infective 14 days after feeding on infected animals; they remain infective for life. Mechanical transmission does not occur after a period of 24 hours. Some of the native wild and domesticated animals have been found infected with the same trypanosome.

KINGHORN, ALLAN AND YORKE, WARRINGTON. A further report on the transmission of human trypanosomes by *Glossina morsitans* Westw. Ann. Trop. Med. & Par. 1912, July 31, 6, No. 2, pp. 269–285. Confirms their earlier observations.

KINGHORN, ALLAN AND YORKE, WARRINGTON. On the influence of meteorological conditions on the development of *Trypanosoma rhodesiense* in *Glossina morsitans*. Brit. Med. Jour. October 5, 1912, pp. 835–837; Ann. Trop. Med. & Par. October 18, 1912, Vol. 6, No. 3, B. pp. 405–413. High temperatures most favorable.

KINGHORN, ALLAN, YORKE, W., AND LLOYD, L. On the development of *Trypanosoma rhodesiense* in *Glossina morsitans*. Ann. Trop. Med. & Par. Vol. 6, No. 4, December 30, 1912, pp. 495–503. The trypanosome was found in the salivary glands of all flies capable of infecting animals.

KLEINE, F. K. The identity and mode of transmission of trypanosomes. Brit. Med. Jour. November 2, 1912, pp. 1183–1185.

LAFONT, A. Note on a Trypanosome from *Conorhinus rubrofasciatus* and its inoculation into the rat and mouse. Compt. Rend. Soc. Biol. (Paris), 72 (1912), No. 9, pp. 380–382, abs. in Sl. Sickn. Bur. (London), Bul. 4 (1912), No. 36, pp. 140–141.

LOW, G. C. Progress in sleeping sickness investigations in Nyassaland and Northeastern Rhodesia. Jour. Trop. Med. & Hyg. Vol. 15, January 15, 1912, pp. 26–27. Discusses the probable results of the recent investigations which show that *G. morsitans* carries *T. rhodesiense* which may prove to be the same as *T. gambiense*.

MACFIE, J. W. SCOTT. Tsetse flies and their bionomics. Bull. Ent. Res. iii, pt. I, May, 1912, pp. 61–72; abs. S. S. Bur. 38, p. 231. The dissemination of the number of tsetse flies in northern Nigeria during the dry season is due to the dryness of the atmosphere and the burnt-up condition of the country.

MESNIL F. *Trypanosoma rhodesiense* and *Trypanosoma gambiense*. Brit. Med. Jour. November 2, 1912, pp. 1185–1186. Compares the two species.

NUTTALL, G. H. F. Trypanosomiasis. Parasit. 5, No. 4, January, 1913. One of the Hector lectures. Particular attention paid to the forms transmitted by Arthropods.

ROBERTSON, MURIEL. Notes on certain aspects of the *Trypanosoma gambiense* in *Glossina palpalis*. Proc. Roy. Soc. Ser. B, 85, No. B. 578, pp. 241–248. Experiments concerned with the proportion of flies in which the trypanosomes will develop.

ROBERTSON, MURIEL. Notes on the life history of *Trypanósoma gambiense*. Abs. Proc. Roy. Soc. 1912, December 17, Ser. B. Vol. 86, No. B 584, pp. 66–71. A brief synopsis of experiments.

STEPHENS, J. W. W. AND FANTHAM, H. B. *Trypanosoma rhodesiense* (Stephens & Fantham) a second species of African trypanosome producing sleeping sickness in man. Brit. Med. Jour. November 2, 1912, pp. 1182–1183. Reasons for regarding this as a distinct species.

The sleeping sickness reservoir. Comment in Brit. Med. Jour. April 27, 1912, p.

969, June 22, 1912, p. 1445. Refers to work of Kinghorn and Yorke which showed that the wild game of Northern Rhodesia harbored *T. rhodesiense* which is closely related to *T. gambiense*, possible only a strain of the latter. It is carried by *G. morsitans*. Discusses the possibility of destroying the game or the flies, both of which seem impracticable but which as yet are the most feasible things suggested for making the infected regions safe.

Reports of the sleeping sickness Commission of the Royal Society. No. 12, 1912, H. M. Stationery Office. Sixteen articles on the results of work of this commission.

The transmission of trypanosomes. Slp. Sick. Bull., No. 35, March 7, 1912, pp. 117–118. Considerable evidence which indicates that they may be transmitted by *Tabanus*, *Hæmatopota*, *Stomoxys*, *Pangonia* and *Lyperosia*.

Rats, Squirrels, Fleas, Plague

Blue, Rupert. Anti-rat ordinances of San Francisco, Cal. Pub. Health Rpts. Vol. 27, No. 33, August 16, 1912, pp. 1319–1329. Texts of various ordinances.

Braddock, C. S. (Jr.). Bubonic plague seen at close range in the far East. Some random notes. N. Y. Med. Jour. Vol. 96, No. 9, August 31, 1912, pp. 419–420. Infected rat fleas passed to dogs and thence to children causing many deaths.

Von Edzdorf, R. H. The occurrence of plague in Habana and the measures adopted for its control and eradication. U. S. Pub. Health Rep. Vol. 27, No. 42, October 18, 1912, pp. 1697–1702. A slight outbreak of plague between July and September, 1912, was controlled by strict quarantine and a well organized fight against rats.

Fox, C. Some common Siphonaptera of Philippine Islands. Phil. Jour. Sci. 7, No. 2, April, 1912.

Guiteras, Juan. Three cases of bubonic plague in Havana. Jour. Amer. Med. Assn. Vol. 59, No. 20, November 16, 1912, pp. 1780–1784. Points out the advantage of letting the public know the true condition of affairs, then their help can be depended upon.

King, Howard D. Plague—the menace of the United States of America. Jour. Amer. Med. Assn. Vol. 59, July 17, 1912, pp. 237–242. Points out the present danger and the part that rats and other rodents might take in the introduction of plague from some of our southern neighbors.

Long, Jno. D. A squirrel destructor. An efficient and economical method of destroying ground squirrels. U. S. Pub. Health Rep. Vol. 27, No. 39, September 27, 1912, pp. 1594–1596. Carbon bisulphide vapor is pumped into the hole by a specially devised pump.

McCoy, Geo. W. and Chapin, Chas. W. Studies of plague, a plague-like disease, and tuberculosis among rodents in California. Pub. Health Bul. No. 53, January, 1912, pp. 1–25. Six papers dealing with these subjects are brought together in this bulletin.

McCoy, Geo. W. Notes on the bionomics of rats and ground squirrels. Pub. Health Rpts. Vol. 27, No. 27, July 5, 1912, pp. 1068–1072. Breeding and feeding in captivity.

McCoy, G. W. and Chapin, C. W. Further observations on a plague-like disease of rodents with a preliminary note on the causative agent, *Bacterium tularense*. Jour. Infec. Dis. 10, No. 1, January, 1912. Have demonstrated that fleas may transmit the disease among squirrels.

Nicoll, William. On the length of life of rat flea apart from its host. Brit. Med. Jour. October 12–26, 1912, pp. 926–928, 1097–1098. Average length of life of *C.*

fasciatus apart from its host is under 7 days. Larval and pupal stages may be prolonged for several months under certain conditions.

PREBLE, PAUL. The tarbagan (*Arctomys bobac*) and plague. Pub. Health Rep. Vol. 27, No. 2, January 12, 1912, pp. 31–39. Notes on the habits and diseases of this animal and its possible relation to plague in humans.

RODIER, ———. The rat problem. Letter in Jour. Trop. Med. & Hyg. Vol. 15, July 1, 1912, pp. 205–207. Discusses the Rodier method of rat extermination which is as follows: catch as many rats as possible alive, kill the females, turn males loose alive. After awhile the males will become more numerous than the females and by worrying the females and killing the young they will destroy all that is left and then die of old age. As long as the rats are polygamous they will increase, but they will decrease when they become polyandrous.

RUCKER, WM. COLBY. The eradiction and prevention of bubonic plague. Pub. Health Rpts. Vol. 27, No. 29, July 19, 1912, pp. 1130–1142. A good summing up of the preventive and protective measures.

RUCKER, W. C. The necessity of rodent extermination in American seaports. Jour. Amer. Med. Assn. Vol. 59, July 27, 1912, pp. 243–244. Danger from these pests and methods of exterminating them, trapping, ratproofing of buildings; cutting off food supply; poisoning.

RUCKER, W. C. How to poison rats. U. S. Pub. Health Rep. Vol. 27, No. 32, August 9, 1912, pp. 1267–1268. A glucose paste containing 4 per cent phosphorous is spread on all sides of small pieces of stale bread and placed in rat holes.

SARGENT, E. AND E., L'HERITIER, A. AND LEMAIRE, G. Transmission of Leishmania from dog to dog by *Pulex serraticeps*. Bul. Soc. Path. Exot. No. 5 (1912), No. 8, pp. 595–597. Experiments gave positive results.

STRONG, R. P. AND TEAGUE, O. Susceptibility of animals to pneumonic plague. Phil. Jour. Sci. Sec. B. (Phil. Jour. Trop. Med.) Vol. 7, No. 3, June, 1912, pp. 223–228. Marmots and tarbagans inoculated with pneumonic strain of plague develop the bubonic type. The latter harbors a flea which bites man.

STRONG, R. P. Studies on pneumonic plague immunization. I. Introduction. The expedition to Manchuria and the conditions under which the work was performed there. Phil. Jour. Sci. Sec. B. (Phil. Jour. Trop. Med.) Vol. 7, No. 3, June, 1912, pp. 131–136.

SWELLENGREBEL, N. H. Contribution to the knowledge of the biology of European rat fleas (*Ceratophyllus fasciatus*). Arch. Schiffs. u. Tropen. Hyg., 16 (1912), No. 6, pp. 169–182. Distribution in Amsterdam, feeding experiments, etc.

TIDSWELL, FRANK. Researches on plague. Second Rep. Gov. Bur. Microbiol. N. S. Wales, September, 1912, pp. 39–43. Includes list of ectoparasites collected from rodents, notes on fleas, etc.

DE VOGEL, W. T. The connection between man and rat in the plague epidemic in Melang, Java, in 1911. Far East Assn. Trop. Med.; Trans. 2nd Bien. Cong. held at Hongkong, 1912, pp. 147–149.

WARREN, E. W. The relation of the rat to the public health. South. Med. Jour. Vol. 5, No. 7, August, 1912, pp. 500–502.

Sixth report on plague investigations in India. Issued by the advisory committee Jour. Hyg. & Plague, Sup. 1. (Vol. 11, December, 1911), pub. 1912, 206 pp. Among other articles some of which deal with the method or spread of the disease is an "Epitome of some recent observations on rat fleas."

Report of the international plague conference held at Mukden, 1911. Man. Bur. of Printing, 1912, 483 pp.

Plague and its relation to maritime quarantine. Pub. Health Rpts. Vol. 27, No.

50, December 13, 1912, pp. 2074–2076. Tells of the campaigns of education in regard to this subject.

March of the black death to the United States. Cur. Lit. 53; October 1912, pp. 426–428. How the plague is being fought.

The steady advance of the plague. Editorial Jour. Amer. Med. Assn., Vol. 59, July 27, 1912, pp. 278–279. Plague now in Trinidad, Porto Rico and Cuba. Danger from Pacific Coast. Need of the public being thoroughly awake to the dangers.

The plague situation. Editorial Jour. Amer. Med. Assn. August 3, 1912, Vol. 59, No. 5, pp. 374–375. Review of present pandemic beginning in 1894. Now encircles the globe. Cuba last to be infected. Danger of it appearing in the southern United States.

The plague situation. Pub. Health Rpt. Vol. 27, No. 36, September 6, 1912, p. 1463. Names places where plague exists at present.

The plague situation. Pub. Health Rpts. Vol. 27, No. 35, August 30, 1912, pp. 1409–1410. Restrictions on passenger traffic from Cuba waived because of no plague cases since July 27.

The rat as a source of economic and health waste. Jour. Amer. Med. Assn. V. 59, No. 7, August 17, 1912, p. 518. Points out the great waste caused by rats and the danger in allowing them to multiply. Suggests that individual property owners be made to keep their premises free.

Rat extermination a public duty. Editorial Jour. Amer. Med. Assn. Vol. LIX, July 27, 1912, pp. 279–280. The need for action in face of the present danger.

Anti-rat ordinance of Seattle, Washington. Pub. Health Rpts. Vol. 27, No. 34, August 23, 1912, pp. 1373–1374. Text of ordinance.

Anti-rat ordinance of Oakland, Cal. Pub. Health Rpts. Vol. 27, No. 34 August 23, 1912, pp. 1371–1373. Text of ordinance.

Spotted Fever

Birdseye, C. Some common mammals of Western Montana in relation to agriculture and spotted fever. Farm. Bull. 484, March, 1912. Notes on species and habits and methods of destroying: relation to the fever.

Birdseye Clarence. Rocky Mountain spotted fever, rodents and ticks. Note in Amer. Jour. Pub. Health 1912, II, No. 3, p. 219. Refers to Farmers Bull. 484 U. S. Dept. Agric.

McClintic, Thos. B. Investigations of, and tick eradication in Rocky Mountain spotted fever. Pub. Health Rep. Vol. 27, No. 20, May 17, 1912, pp. 732–756. A detailed record of field and laboratory investigations. Dipping domestic stock, destruction of wild mammals and the clearing and burning over of land are recommended.

Reed, A. C. Spotted fever. Hero of peace. Outlook, 102; September 28, 1912, pp. 178–179. Notes on spotted fever and the life of Dr. T. B. McClintic who died of the fever contracted while studying it.

Rucker, W. C. Rocky Mountain spotted fever. Pub. Health & Mar. Hos. Serv. U. S., Pub. Health Rpts. 27 (1912), No. 36, pp. 1465–1482. A summarized account; bibliography.

Another martyr to scientific medicine. Jour. Amer. Med. Assn. 59, No. 7. August 17, 1912, p. 550. Dr. T. B. McClintic of the U. S. Pub. Health Serv. died in Washington August 13, 1912, of Rocky Mountain spotted fever contracted while investigating the disease in Montana. He was regarded as the leading authority on this disease.

Ticks and Various Diseases

Bishopp, F. C. The fowl tick (*Argas miniatus* Koch). U. S. Bur. Ent. Circ. 170, March 31, 1913. Distribution, life history, control.

Bishopp, F. C. A new species of Dermacentor and notes on other North American Ixodidæ. Proc. Biol. Soc. Wash. 25 (1912), pp. 29–37. *D. hunteri* taken on mountain sheep.

Christophers, S. R. The development of *Leucocytozoon canis* in the tick with a reference to the development of Piroplasma. Parasit. 5 No. 1. February, 1912.

Dalrymple, W. H. Anthrax and tick fever. Amer. Vet. Rev. 40 (1912 , No. 5. pp. 601–610. The housefly and the ant and probably other insects often coming in contact with anthrax flesh may become dangerous carriers of the infection.

Dalrymple, W. H. Anthrax and tick fever. Amer. Vet. Rev. 40 (1912), No. 6, pp. 757–764. Deals with Texas fever, the cattle tick and its eradication.

Graybill, H. W. Studies on the biology of the Texas fever tick. Bul. 152, U. S. Dep. Agric., 1912. 13 pp.

Graybill, H. W. Methods of exterminating the Texas fever tick. U. S. Dept. Agr. Farmers Bul. 498, 1912, 42 pp. Life history and methods of control by dipping and pasture rotation.

Hindle, E. Attempts to transmit "fowl pest" by *Argas persicus*. Bul. Soc. Path. Exot., 5 (1912), No. 3, pp. 165–167. Results negative.

Hindle, E. and Merriman, G. The sensory perceptions of *Argas persicus*. Parasit. 5, No. 3, September, 1912. An interesting series of experiments. "Haller's organ" regarded as olfactory.

Hooker, W. A., Bishopp, F. C. and Wood, H. P. The life history and bionomics of some North American ticks. U. S. Dept. Agric. Bur. Ent. Bul. 106, p. 239. General bionomics of the group and life history of several species.

Jennings, Allan H. Some notes on the tick *Ornithodorus talaje* Guerin. Proc. Ent. Soc. of Wash. Vol. 14, No. 2, April–June, 1912, pp. 77–78. Records this species from rats in Canal Zone.

Moore, Wm. The tick problem in South Africa. Jour. Econ. Ent. Vol. 5, 1912, No. 5, pp. 377–384. List of ticks known to transmit diseases and other ticks that attack animals in South Africa. Notes on life history of some of the species. Control methods.

Nuttall, G. H. F. Notes on ticks: II, New species (*Amblyomma, Hamaphysalis*); *Ixodes putus:* Description of the hitherto unknown larval stage. Par. 5 (1912), No. 1, pp. 50–60. Three new species described.

Ransom, B. H. Eradication of the Southern cattle tick. Proc. 7th Inter. Zoöl. Cong., pp. 648, 655. (Paper read August, 1907, pub. 1912.) Loss estimated at $40,000,000 annually. Methods of control. Rotation of pastures most efficient.

Ransom, B. H. and Graybill, H. W. Investigations relative to arsenical dips as remedies for cattle ticks. U. S. Dept. Agric. Bur. Anim. Indus. Bul. 144, pp. 65.

Theiler, A. The transmission of gall-sickness by ticks. Agr. Jour. Union So. Africa, 3 (1912), No. 2, pp. 173–181.

Warburton, C. Notes on the genus *Rhipicephalus*, with the description of new species, and the consideration of some species hitherto described. Parasit. 5, No. 1, February, 1912.

Spirocheta

Bayou, H. The experimental transmission of the spirochæte of European relapsing fever to rats and mice. Parasit. 5, No. 2, June, 1912. Believes that in Moscow, relapsing fever is commonly transmitted by *Pediculus vestimenti* and not by *Cimex*.

HINDLE, E. The inheritance of spirochetal infecton in *Argas persicus*. Proc. Cambridge Phil. Soc. 16 (1912), No. 6, pp. 457–459. A tick once infected transmits the infection to its offspring of the first and second generation.

NUTTALL, G. H. F. Spirochætosis. Parasit. 5, No. 4, January, 1913. One of the Herter lectures. Deals particularly with those diseases that are transmitted by ticks, lice, bedbugs. Also gives important notes on the life history of the body louse.

ROSS, PARK. Human spirochætosis. Transv. Med. Jour. Vol. 7, No. 7, February, 1912. Review of work done on the disease. Some of the natives fear the tick *Ornithodorus* and will not sleep in infested huts.

DOBELL, CLIFFORD. On the systematic position of the Spirochætes. Proc. Roy. Soc. ser. B, Vol. 85, No. B 578, June 14, 1912, pp. 186–191. Classification must be based on morphological evidence. Believes that they are more closely related to the Bacteria than to Protozoa or *Cyanophyceæ*.

BEDBUGS AND VARIOUS DISEASES

FANTHEM, H. B. Some insect flagellates and the problem of the transmission of Leishmania. Brit. Med. Jour. November 2, 1912. pp. 1196–1197.

GIRAULT, A. A. Preliminary studies on the biology of the bedbug, *Cimex lectularius*. II Facts obtained concerning the duration of its different stages. Jour. Eco. Biol. 7, No. 4, December, 1912. Under favorable conditions the bug breeds continuously throughout the year, but there may be at least three or four generations. Gives duration of life of different stages under various conditions.

MANNING, J. V. A contribut'on to the study of the possible agency of the bedbug, *Cimex lectularius*, in transmission of acute poliomyelitis from man to man. Med. Times, vol. 60, April, 1912. Shows that the bedbug fullfils the necessary requirements as a carrier of this disease.

MANNING, J. V. Bedbugs and bubonic plague. Med. Rec. Vol. 82, No. 4, July 27, 1912, pp. 148–150. Refers to Vubitski's experiments and gives notes on habits and control.

OLSEN, C. E. On the endurance of swarms of *Cimex lectularius* L (Hemip). Bul. Brooklyn Ent. Soc. Vol. 8, December, 1912, pp. 24–25. Specimens kept alive in bottles two or three months.

PATTON, W. S. Kala-Azar problem. Brit. Med. Jour. 2, No. 2705, November 2, 1912.

PATTON, W. S. Preliminary report on an investigation into the etiology of oriental sore in Cambay. Sci. Mem. by Offi. of Med. & San. Dept. of Govt. India, n. s., No. 50, 1912. Believes that the bedbug is the transmitter of this disease.

PATTON, W. S. The development of the parasite of Indian Kala-Azar (*Herpetomonas donovani* Laveran & Mesnil) in *Cimex rotundatus* Sign. and in *Cimex lectularius* Linn. with some observations on the behavior of the parasite in *Conorrhinus rubrofasciatus* de Geer. Sci. Mem. by Offi. of Med. San. Dept. Govt. India, 1912, (n. s.), No. 53, p. 38.

RIGGS, R. E. Bedbug as carrier of typhoid. Mil. Surg. XXXI, No. 3, September, 1912.

RUCKER, W. C. The bedbug. Pub. Health Rpts. Vol. 27, No. 46, November 15, 1912, pp. 1854–1856. Notes on habits and control.

WENYON, C. M. Experiments on the behavior of Leishmania and allied flagellates in bugs and fleas, with some remarks on previous work. Jour. Lon. Sch. Trop. Med. Vol. 2, pt. 1, December, 1912, pp. 13–26.

Etiology of Kala-azar. Nature 89, June 13, 1912. pp. 386–388. Notes on a

lecture by W. S. Patton in which he discusses the relation of the parasite that causes the disease, to its hosts.

Kala-azar and the bedbug. Lancet (London), 1912, I, No. 8, p. 520. Discussion of recent investigations.

Sensational aspects of the bedbug peril. Cur. Lit. 53; October, 1912, pp. 420–421. Refers to the papers of Manning and others showing the possibility of this insect carrying disease.

Mode of propagation of infantile paralysis: the bedbug as a spreader of disease. Sci. Am. S 73, May 11, 1912. p. 229. Review of Dr. Manning's article in Medical Times in which he gives reasons for believing that the bedbug may spread this disease.

Typhus Fever

Anderson, John F. The relation of so-called Brill's disease to typhus fever' An experimental demonstration of their identity. Pub. Health Rep. 27, No. 5' February 2, 1912; also in Hyg. Lab. Bul. No. 86, October, 1912, pp. 25–35. Concludes that the two diseases heretofore considered as distinct are the same.

Anderson, John F. Studies on immunity and means of transmission of typhus. Hyg. Lab. Bul. 86, October, 1912, pp. 81–138. Experiments relating to the hereditary transmission of the virus in the body louse gave negative results. A few experiments relating to the transmission of this disease by bedbugs also gave negative results.

Anderson and Goldberger. Demonstration of the identity of the so-called Brill's disease with typhus. Pub. Health Rep. February 2, 1912, p. 149, Jour. Amer. Med. Assn. February 10, 1912, p. 414.

Birt, C. Typhus fever. Jour. Roy. Army Med. Corps. Vol. 19, No. 5, November, 1912, pp. 521–529. Summary of our present knowledge of this disease and the methods of transmission.

Goldberger, Jos. Studies on the virus of typhus. Duration of the infectivity of the blood. Hyg. Lab. Bul. No. 86. October, 1912, pp. 49–80. Reprinted from Pub. Health Rpts. 27, No. 22, May 31, 1912. Includes account of some experiments with the virus of the louse.

Goldberger, Jos. and Anderson, John F. The transmission of typhus fever, with especial reference to transmission by the head louse (*Pediculus capitis*). Pub. Health Rep. Vol. 27, No. 9, March 1, 1912, pp. 297–307. Review of our present knowledge in regard to the spread of the disease and record of experiments. Conclude that the virus may be transmitted by lice.

Goldberger, Jos. and Anderson, J. F. Some recent advances in our knowledge of typhus. Jour. Amer. Med. Assn. 5, 59, No. 7, August 17, 1912, pp. 514–517. Among other things they discuss the transmission of this disease by body lice and possibly by head lice and show that Brill's disease is the same as typhus, thus this problem is of direct interest to Americans.

Hewitt, C. Gordon. Transmission of typhus fever by lice. Can. Ent. XLIV 4, April, 1912, p. 103. Refers to Goldberger and Anderson's paper (Pub. Health Rep. March 1, 1912) in which they show that *P. capitis* as well as *P. vestimenti* may carry typhus fever and points out the importance of this.

Collected studies of typhus. Hyg. Lab. Bull. No. 86, October, 1912. A bringing together of a series of papers on this disease published in 1911–12. Those published in 1912 are listed above.

Typhus fever. Jour. Amer. Med. Assn. Vol. 59, No. 25, December 21, 1912, pp. 2258–2260. Editorial reviewing the recent work by various investigators of this subject.

Lice

Fantham, H. B. *Herpetomonas pediculi*, nov. spec. Parasitic in the alimentary tract of *Pediculus vestimenti*, the human body louse. Proc. Roy. Soc. ser. B. Vol. 84, February 14, 1912, pp. 505–517. (No. B 574.) also in Ann. Trop. Med. & Par. March 29, 1912. Attempts to introduce this parasite into vertebrates failed. It shows no connection with any vertebrate trypanosome.

Girault, A. A. Notes on *Pediculus vestimenti* Nitzsch, the body louse of man. Ent. News 23, No. 8, October, 1912. Notes on feeding habits of certain reared broods.

McCoy, G. W. and Clegg, M. T. A note on acid-fast bacilli in head lice. (*Pediculus capitis.*) Pub. Health & Mar. Hos. Serv. U. S. Pub. Health Rep. 27, 1912. No. 36, pp. 1464–1465. Lice that had fed on leprous patients showed organisms indistinguishable from the leprosy bacilli.

Nicolle, C. Blaizot, L. and Conseil, E. I. Etiologie de la Fièvre Récurrente. Son Mode de Transmission par le Pou. II. Conditions de Transmission de la Fièvre Récurrente, par le Pou. Compt. Rend. de l'Acad. Sci. Vol. 154, No. 24. June 10, 1912, pp. 1636–1638 and also Vol. 155, No. 9, August 26, 1912, pp. 481–484; also (i) in Arch. Inst. Pasteur Tunis, No. 3, 1912, pp. 110–112. Records the first actual experiments to show that the relapsing fever may be transmitted by body lice.

Typhus fever and the head louse. Note in Amer. Jour. Pub. Health, 1912, 2 No. 3, pp. 215–216. Believe that the fever may be transmitted by the bite of the insect.

Miscellaneous Articles

Banks, Nathan. The structure of certain dipterous larvæ with particular reference to those in human foods. Bur. Ent. Tech. Ser. No. 22, January 10, 1912. Gives a synopsis of such flies and note on the life history of many of them.

Blue, Rupert. The problem of the public health. Jour. Amer. Med. Assn. Vol. 59, No. 6, August 10, 1912, pp. 413-415. Refers to the gradual development of the various organizations to promote public health and shows the necessity of all working together.

Brues, C. T. Blood-sucking insects as carriers of human diseases. Proc. Ent. Soc. Wash. 14, No. 3, September, 1912, p. 180. Notes on Dr. Knab's article (same vol. p. 79–81) pointing out certain conditions that Knab seems to have overlooked.

Brues, C. T. Insects as agents in the spread of disease. Pop. Sci. Mon. December, 1912, pp. 537–550. A comprehensive review.

Castellani, Aldo. Note on Copra itch (with report on the mite causing it, by Stanley Hirst) Jour. Trop. Med. & Hyg. Vol. 15, No. 24. December 15, 1912, pp. 374–375. A variety of mite, *Tyroglyphus longior* var. *castellanii*, found commonly in copra dust often causes an eruption on people handling copra.

Castellani, A. Copra itch. Brit. Med. Jour., 2, No. 2705, November 2, 1912.

Cleland, J. B. The relationship of insects to disease in man in Australia. Sec. Rep. Gov. Bur. Microbiol. N. S. Wales, September, 1912, pp. 141–158. Many interesting notes on the insects of the various orders. List of flies caught on breakfast tables.

Doane, R. W. An annotated list of the literature of insects and disease for 1911. Jour. of Econ. Ent. June, 1912, pp. 268–285.

Herms, W. B. Economic entomology from the viewpoint of the sanitarian. Jour. Econ. Ent. Vol. 5, No. 4, August, 1912, pp. 355–357. The importance of a knowledge of entomology in dealing with many sanitary problems.

Howard. L. O. and Popenoe, C. H. Hydrocyanic-acid gas against household insects. U. S. Bur. Ent. Circ. No. 163, November 20, 1912. Directions for use.

Howard, C. W. Insects directly or indirectly injurious to man and animals

in Mozambique, East Africa. Bul. Ent. Res. Vol. 3, pt. 2, August, 1912, pp. 211–218. An annotated list.

Hunter, W. D. American interest in medical entomology. Jour. Econ. Ent. Vol. 6, No. 1, February, 1913, pp. 27–39. Points out the importance of the work and the desirability of more entomolog'sts devoting their time to it.

Knab, Frederick. Blood-sucking insects as transmitters of human disease. Proc. Ent. Soc. Wash. 14, 1912, p. 219. Replies to Brues' criticism of one of his former papers.

Knab, Frederick. Unconsidered factors in disease transmission by blood-sucking insects. Jour. Econ. Ent. Vol. 5, April, 1912, pp. 196–200. Points out that an insect must be more or less closely associated with man and habitually suck his blood if they are to be factors in the transmission of human blood diseases.

Neave, S. A. Notes on the blood-sucking insects of Eastern tropical Africa. Bul. Ent. Res. Vol. 3, pt. 3, November, 1912, pp. 275–324. An annotated list.

M. Neveu-Lemaire. Parasitology of domestic animals. Par des Animaux Domes.: Maladies Paras. non Bacter. Paris, 1912, pp. 1257. Vegetable and animal parasites of domestic animals, host lists and short bibliography.

Nicoll, W. Flies and other insects as carriers of infection. Brit. Med. Jour., 2, No. 2704, October 26, 1912.

Novy, F. G. Disease carriers. Science, July 5, 1912, pp. 1–10. Four pages devoted to discussion of insects and disease.

Rucker, W. C. Insects and disease: the mechanical and biological methods of transmission. Sci. Am. 107, July 13, 1912, pp. 34–35. Setting forth the dangers from the presence of certain insects.

Sergeois, E. The role of insects as carriers of disease. Abs. in Jour. Amer. Med. Assn. 58, (1912), No. 8, pp. 594–595. A study of the bedbug and its possible relation to disease. Ordinarily plays the part of carrier only, seldom a host. Such diseases as relapsing fever and kala-azar probably remain epidemic in certain places on account of the bedbugs.

Simpson, Jas. J. Entomological research in British West Africa. II Northern Nigeria. Bul. Ent. Res. Vol. 2, pt. 4, January, 1912, pp. 301–356. Includes records of blood-sucking insects and other arthropods. Native names for insect and diseases carried by them. Protozoal diseases in man and other animals; remedial measures.

Snyder, C. Reservoirs of contagion. Harpers 125, November, 1912, pp. 832–838. Many different kinds of animals have been shown to act as reservoirs in which are stored germs that cause disease in the same or other animals.

Tidswell, F. A review of the present situation as regards infectious protozoa. Sec. Rep. Gov. Bur. Microbiol. N. S. Wales, September, 1912, pp. 62–70. Important. List of parasites—hosts and carriers.

Williams, H. A. Messengers of death. Cosmop. 53, 724–735, November, 1912. Popular notes on several insects that carry disease.

Insects. The common forms in relation to public health and methods for their destruction. Pa. Health Bull. No. 32.

Insects as carriers of infectious diseases. Jour. Amer. Med. Assn. Vol. 59, No. 20, November 16, 1912, p. 1798. Editorial pointing out the importance of the recent discoveries.

Two pictures—a contrast. Comment Jour. Amer. Med. Assn. Vol. 59, July 6, 1912, p. 43. January 1 to June 1, 1912, Guayaquil had 147 cases yellow fever, 124 cases of bubonic plague. This is the "Pest hole of the Pacific." No cases of yellow fever or plague and but comparatively little sickness in Panama Canal Zone during the same period; used to be as bad as Guayaquil.

JOURNAL OF ECONOMIC ENTOMOLOGY

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AUGUST, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The Entomological Society of Ontario will be celebrating its semi-centennial about as this number appears. The half century has been a period of progress and much of accomplishment must be credited to the residents north of a line political—not racial, social or faunal. Their problems are our problems. The long series of reports of this society and the numerous volumes of Canadian Entomologist contain a host of records concerning American insects, data of great value to all students of entomology. The organization may rightfully claim the honor of founding and supporting the oldest regularly issued entomological serial in the New World. This achievement alone is worthy of high praise. We are quite certain that all active entomologists, both economic and systematic, would gladly join in the felicities of the occasion and congratulate most heartily our Canadian friends on the record of the past and the even more brilliant prospects of the future.

There was a time when an entomologist was regarded as a man of limited outlook or at least a trifle narrow and inconsequential. Now certain entomological specialists appear to look upon the general student of insect life as a somewhat trifling jack-of-all-trades who accomplishes little of real value. There is more or less truth in both of these attitudes. American entomologists of the practical persuasion are mostly specialists and perhaps never happier than when learning new life histories or ascertaining hitherto undreamed of biological relationships. Such investigations, limited as they are to individual insects or more or less natural groups add, and add greatly to the sum of human knowledge and do much to increase the honor accorded the profession both in this country and abroad. There is such a thing as getting too close to a problem. It is possible to spend all our energy fighting an insect or studying individual pests so that no time or strength can be given to the broader prophylactic measures. International quarantine is excellent as a preventive though of little service after a pest has become well established. Why is one insect

a pest and a close ally insignificant? What are the determining factors in the case of either chronic or periodically injurious species? May any of these factors be modified to the practical advantage of man? Some men are giving more or less time to such problems, though usually in an incidental way and generally in relation to individual pests. Are not some of these broader questions worthy of the same concentration so frequently given problems of pressing practical importance?

Current Notes

Conducted by the Associate Editor

Sir John Lubbock (Lord Avebury) died May 28, aged 79 years.

A new foul brood law has been enacted in Connecticut, becoming operative August 1.

Columbia University recently conferred the honorary degree of Doctor of Science upon Wm. C. Gorgas.

Professor George H. Parker was elected a member of the National Academy of Sciences at Washington, April 22–24.

Dr. C. Gordon Hewitt, Dominion Entomologist of Canada, was recently elected a Fellow of the Royal Society of Canada.

Professor T. D. A. Cockerell has received the honorary degree of Doctor of Science from Colorado College.

Mr. William Harper Dean, assistant and instructor in Entomology at the Texas College and Station, resigned April 1.

Professor S. W. Williston received the honorary degree of Doctor of Science from Yale University, June 18.

Mr. A. J. Mutchler has been appointed assistant in the department of invertebrate zoölogy at the American Museum of Natural History, New York City.

At the ecological conference at the University of Chicago this summer, Professors S. A. Forbes and Wm. M. Wheeler are to give illustrated lectures.

Dr. E. P. Sansten, recently appointed horticulturist of the College and Station at Auburn, Alabama, has resigned to accept a similar position at the Colorado State College.

W. E. Dove, a recent graduate of the Mississippi Agricultural College is now employed by the United States Bureau of Entomology and is located at Dallas, Texas.

Dr. M. W. Blackman, of the zoölogical department of Syracuse University, has been made associate professor of entomology in the New York State College of Forestry, Syracuse University.

Mr. W. F. Fiske, who has been connected with the gypsy moth parasite laboratory for several years, has resigned from the Bureau of Entomology and is spending the summer in Europe.

Assistant Surgeon General Wm. C. Gorgas, Professors J. H. Comstock and C. E. McClung, were elected members of the American Philosophical Society at Philadelphia, on April 19.

Mr. Benjamin W. Douglas, formerly state entomologist of Indiana, has started in business as a landscape gardener in Indianapolis,and will take charge of the planting of several large estates.

Charles H. Gable, entomologist and horticulturist for an Ottawa Kansas nursery, has been appointed by the government of Portugal to go to the Maderia Islands, to supervise work on the large fruit farms.

Mr. U. C. Loftin, formerly laboratory assistant in entomology at the Agricultural Experiment Station at Gainesville, Fla., is now an assistant in the Bureau of Entomology, and is stationed at Audubon Park, New Orleans, La.

Three of the recent graduates of the Mississippi Agricultural College, N. D. Guerry, J. C. Treloar, and H. O. French, are temporarily employed by the Bureau of Entomology and are now located at Tellulah, La., and are engaged in boll-weevil work.

The following changes have taken place recently in the Federal Horticultural Board: A. V. Stubenrauch succeeds Peter Bisset, and Dr. W. D. Hunter succeeds A. F. Burgess. Mr. Burgess resides in Melrose, Mass., and it was inconvenient for him to attend the meetings of the Board.

Professors Herbert Osborn, Ohio State University, Alexander D. MacGillivray, University of Illinois and Mr. Charles P. Alexander, Cornell University, will spend their summer vacations at the Agricultural Experiment Station at Orono, Me., and each will study the insects of the special group in which he is an authority.

According to *Science*, Mr. G. N. Wolcott, who is the traveling entomologist supported by the Porto Rico Sugar Growers' Association, is collecting parasites of the white grub to introduce into Porto Rico, where the white grubs are a very serious pest in the cane fields. Mr. Wolcott has his chief headquarters in the United States at the University of Illinois.

Professor A. L. Melander, Entomologist of Washington State College and Experiment Station at Pullman, has been granted a year's leave of absence for purposes of study. During the summer he will be at the Biological Laboratory at Cold Spring Harbor, and during the next college year will study under Dr. W. M. Wheeler at the Bussey Institution of Harvard University, Forest Hills, Mass.

According to *Science*, at the twenty-fifth reunion of the class of 1888 of Washington and Jefferson college, on June 17, a library memorial fund was established in honor of Dr. Jesse W. Lazear, U. S. A., a member of the class, who left before graduation to study medicine and who afterward became a member of the commission to investigate the rôle of the mosquito in the transmission of yellow fever, and sacrificed his life to the cause of scientific research.

A new organization is the Audubon Entomological Club, the first meeting of which was held at the office of the Bureau of Entomology at Audubon Park, New Orleans, La., on May 27, 1913. The general purpose of the Club will be the discussion of entomological subjects, especially in connection with the work of the various members. The Club will be entirely informal, and will have neither a constitution nor officers. The members, most of whom are connected with the Bureau of Entomology, are the following: Messrs. E. R. Barber, J. R. Horton, W. V. King, T. E. Holloway and Dr. Wm. E. Cross.

A hearing was held before the Federal Horticultural Board, at Washington, D. C., June 12, at 10 o'clock A. M. The question of extending the present quarantine lines in the New England States, on account of the spread of the gypsy and brown-tail moths, was considered.

In addition to the members of the Board the following entomologists were present: W. C. O'Kane, Durham, N. H.; A. F. Burgess, D. M. Rogers and L. H. Worthley, Boston, Mass.; W. E. Britton, New Haven, Conn.; E. D. Sanderson, Morgantown, W. Va., Congressman Roberts of Massachusetts, and a number of Christmas tree shippers were present.

Issued August 15, 1913.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

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H. A. GOSSARD, Wooster, Ohio.

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E. MEAD WILCOX, Lincoln, Nebraska.

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R. W. BRAUCHER, Kent, Ohio.

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A BROOD STUDY OF THE CODLING MOTH

By Thomas J. Headlee,[1] Ph.D., *New Brunswick, N. J.*

Introduction

No phase of the life history of the codling moth is more important from the standpoint of control than the number and succession of broods. This part of the creature's natural history determines the periods during which fruit and foliage must be kept covered with a poisonous coating.

The influence of climate on the metabolism of the moth is such that the study of broods gives different results for every section. It is probable that if we knew the exact effect of the climate we could form a close estimate of the number of broods, the dates of their appearance and duration in any locality, providing the climate of that locality were known. In the absence of this exact knowledge we are compelled to make a brood study of this insect in every region where its work is important.

It has long been assumed that Kansas has two broods of codling moth, but the evidence of recent investigation indicates the presence of a partial third brood. In the year 1910, the tabulation of moth emergence at Parker, Kansas, indicated the emergence of a partial third brood which was not supported by records of larval emergence. In the year 1911, Mr. L. M. Peairs, working in northeastern Kansas, observed evidences of a third brood which he published in the Journal of Economic Entomology, Vol. 5, pp. 243–245.

In the year 1912, the writer planned a careful cage study of the broods for the purpose of demonstrating the presence or absence of a third brood in that state. Cages were employed, because in view of the overlapping of the broods the claims for third brood, based on records of

[1] The data on which this paper is based were collected by the writer while head of the department of entomology and zoölogy in the State Agricultural College and Experiment Station of Kansas.

larval emergence and work, pupation, and emergence of adults have never seemed absolutely conclusive.

Sources of Material Used

Table Showing the Transformation of the Larvæ Collected During June, July, August, September, October and November, 1911.

Number	Larvæ collected during	Number which pupated in 1911	Number which pupated in 1912	Number that died
8	June 1911	2	0	6
85	July 1911	68	0	17
196	August 1911	93	48	55
371	September 1911	0	145	226
359	October 1911	0	98	261
140	November 1911	0	15	125

More than 800 larvæ emerging during the late summer and fall of 1911 were enclosed in cotton-plugged glass vials and stored as the weather grew cold in a box 20 inches below the surface of the ground. In this box they were adequately protected from moisture. Forty-eight larvæ were collected from the trunks of apple trees on March 29, 1912, and enclosed in vials in a similar manner.

Pupation in the first group reached the maximum by or before May 7, 1912 and ceased May 28, all that were alive transforming. Adult moths began to emerge May 16, reached the maximum by May 27, and ceased June 15. Pupation of the second group began April 15. Adult moths began to emerge May 11, reached the maximum by May 23, and ceased by May 27.

Breeding Cage Arrangements

The first tree-cage consisted of ordinary screen wire tacked over a wooden frame which was 18 feet square and 18 feet high. This cage was set up May 15, 1912, over an unsprayed Jonathan, which stood about 17½ feet high and filled the cage well. The tree was at once very carefully gone over for eggs of the moth; but none were found, and the trunk and larger branches were very carefully "wormed."

The second tree-cage, made of similar size and of similar material, was completed over another unsprayed Jonathan apple tree on June 1, 1912. The trunk and larger branches were carefully "wormed" and all eggs and all wormy apples removed at intervals of a few days to June 27.

The third tree-cage was the first cage removed from the Jonathan apple tree and placed over a Salome apple tree on July 27, 1912. The

trunk and branches were carefully "wormed," all eggs removed to August 6, and all apples showing traces of infestation to August 12.

Actual Breeding

Moths to the number of 163 drawn from sources described already in this paper, and therefore of the first brood, were introduced into the

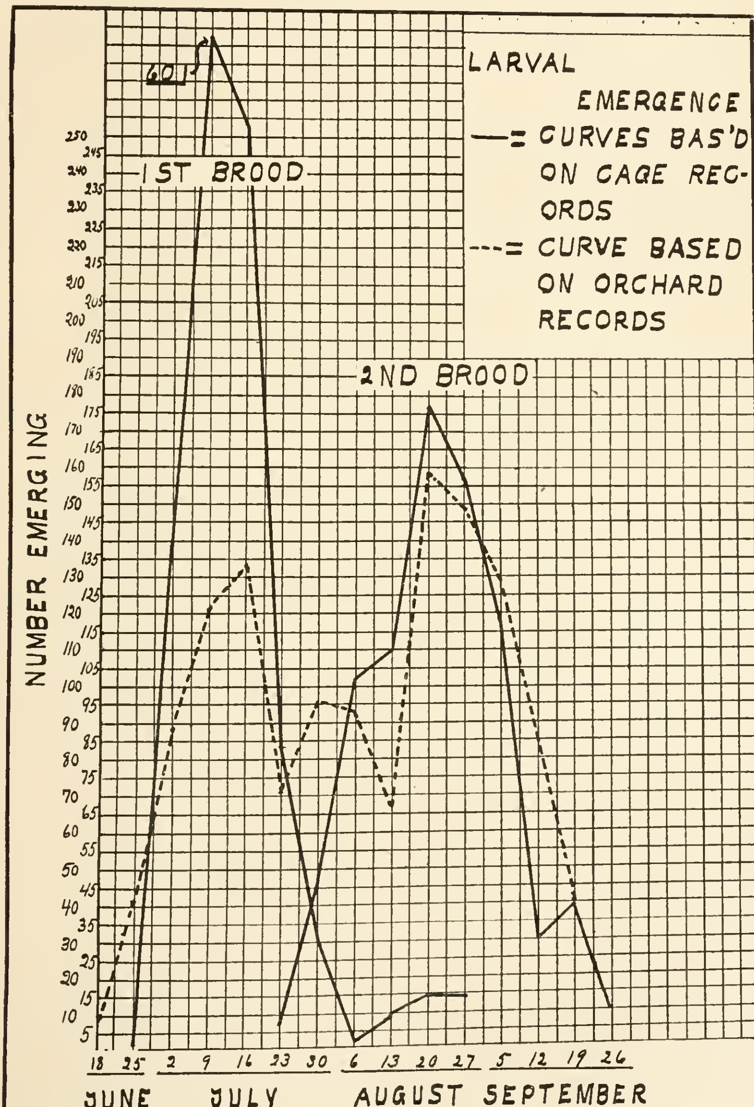

Fig. 7. Chart representing the number of appearances of each stage of the codling moth and the period occupied by each appearance, as shown by cage studies.

first tree-cage as follows: May 25–29, 27–28; 28–30; 29–6; 30–15; 31–7; June 1–13; 2–12; 4–4; 6–8; 7–4; 10–1; 11–4; 14–2.

The first eggs appeared on May 27 and the last were found on July 4. The first worminess became evident on June 4, and the maximum (using this term to mean one-half of all that appeared) worminess was reached between June 24 and 28. The first of the 1123 larvæ that came from this tree appeared under the bands on June 24, the maximum was reached by July 5 and the last emergence came July 31. Pupation of these larvæ began on June 26, reached the maximum July

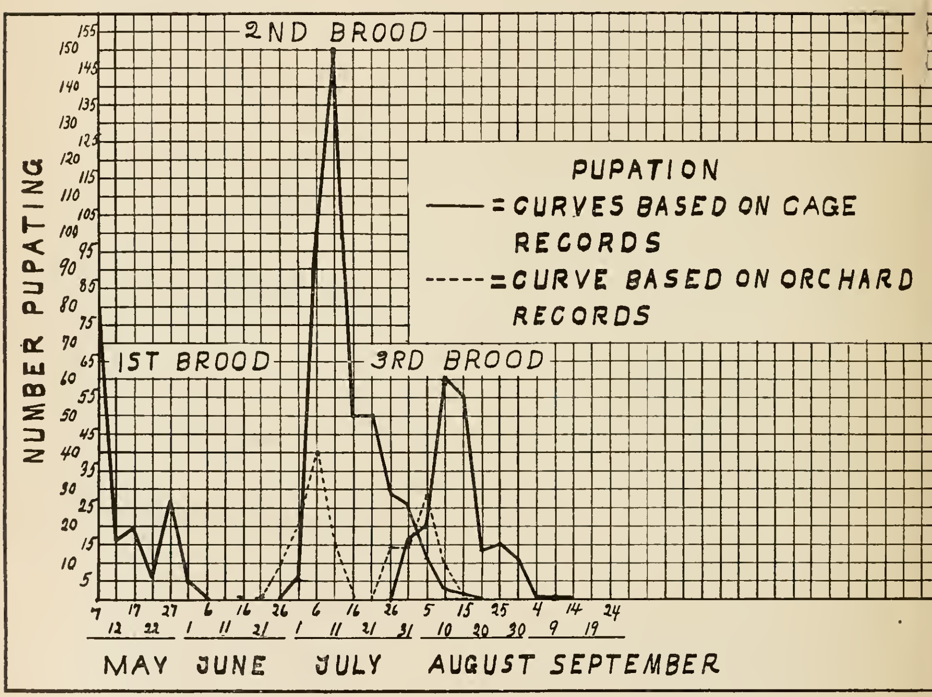

Fig. 8. Chart representing the number of separate pupation periods as shown by cage and field studies in 1912. The pupation of overwintering brood in the orchards was represented by too small a number to render the construction of a curve worth while.

10 and ceased August 11. All larvæ either transformed or died. Emergence of adults began July 5, reached the maximum July 23 and ceased August 21.

Three hundred and seventy-six of the moths which emerged from the first tree-cage were introduced into the second tree-cage as follows: July 5–9; 6–10; 7–17; 8–18; 9–17; 10–12; 11–20; 12–27; 13–40;

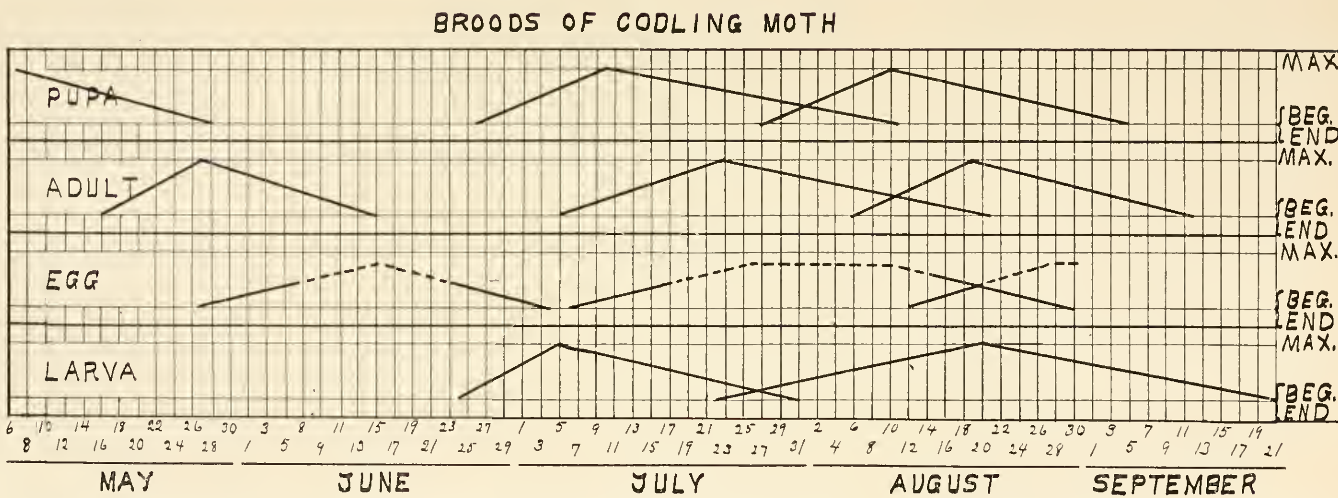

Fig. 9. Chart representing the number of separate moth emergence periods as shown by cage and field studies in 1912. The emergence of the overwintering brood in the orchards was represented by too small a number to render the curve significant.

14–35; 15–16; 16–10; 17–8; 18–63; 21–18; 22–11; 23–13; 24–8; 25–4; 26–6; 29–14.

The first eggs of which we could be certain came July 6 and the last about August 30. The maximum of worminess was reached between July 21 and 24. The first of the 673 larvæ appeared under the bands on July 22, the maximum number by August 20, and they ceased coming by September 21. Pupation of these larvæ began July 27, reached the maximum August 10 and ceased September 5; 48 per cent of the larvæ which emerged from this cage transformed, while 52 per cent

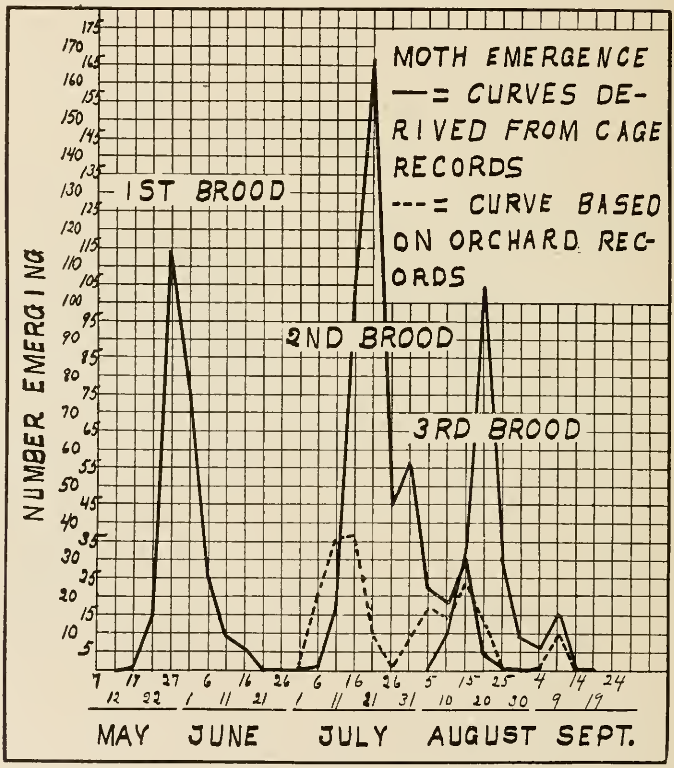

Fig. 10. Chart representing the number of separate larval emergence periods as shown by cage and field studies in 1912.

entered the winter as larvæ. Emergence of the moths began August 6, reached the maximum August 19 and ceased September 12.

Seventy-seven of these moths were placed in the third tree cage as follows: August 6–3; 7–1; 8–2; 11–2; 12–4; 13–5; 14–3; 15–3; 16–7; 17–9; 18–11; 19–10; 25–1; 26–2; 27–1; 29–2; September 1–3; 5–5; 6–2; 12–1. The first eggs appeared August 12, and the first evidence of worminess was detected August 18.

Actual Number of Broods

In Fig. 7, the succession of each stage of the insect is graphically set forth. Three separate and distinct emergences of adult moths are shown. Three definite egg-laying periods are indicated. Three distinct pupation periods are set forth. Two distinct larval emergences are charted. Thus it appears that in 1912, in the course of the outdoor tree-cage studies at Manhattan, three distinct and successive appearances of each of the codling moth's stages, except of larval emergence, were determined. The third emergence of codling moth larvæ would come during late September and October. In view of the fact that larvæ emerging during late September and October in 1911, pupated and produced moths in the spring of 1912, it seems entirely likely that these larvæ of the third brood matured, emerged, hibernated, pupated, and produced moths in the spring of 1913.

The fact that only 48 per cent of the larvæ of the second brood pupated this season, shows that the third brood is only partial.

That the record obtained from cage breeding sets forth substantially what happened in the field is shown by the close correspondence between pupation, moth emergence, and larval emergence curves derived from the cages and from field records as illustrated in Figs. 8, 9, and 10.

That the two full and a partial third brood cycle is not confined to the year 1912 is shown by the fact that the moth emergence for 1910 clearly indicated three broods.

The failure of the curves of larval emergence derived from band records to indicate a third brood for the years 1910 and 1911 is due to the fact that the late second brood so overlaps the small third brood as to cause the collection to grade steadily down to the end, while the same phenomenon in 1912 is due to the fact that the data for late September and October are not available to the writer.

Therefore, it seems very likely that the codling moth normally experiences two full broods and a partial third at Manhattan, Kansas.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., OF
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A. F. Burgess, Business Manager.

Sworn to and subscribed before me this 12th day of September, 1913.

A. Hartwell Balcom, Notary Public,
Melrose Highlands, Mass.
Term expires April 29, 1920.

ON THE PUPAL INSTAR OF THE FRUIT-TREE LEAF-ROLLER (ARCHIPS ARGYROSPILA WALKER)[1]

By W. M. Davidson, *U. S. Bureau of Entomology, Walnut Creek, Cal.*

During the summer of 1911 the writer found occasion to study the pupal instar of the Fruit-tree Leaf-roller at San Jose, Cal.

In California the larvæ of this insect hatch from the winter eggs at about the time when the fruit buds are just beginning to open. This period varies with the season and is usually from the last week in February to the third week in March, as at least three weeks elapse from the time of the opening of the buds of the earliest until that of the latest varieties of fruits attacked. Pears, plums, prunes, cherries and apples are infested, the greatest damage occurring on the three first-mentioned varieties. The larvæ at first feed inside the bud and protect themselves further with a web, but later they repair to the foliage and, inhabiting the upper surface of the leaves, cause the characteristic rolling. Pupation takes place in the rolled leaf, the chrysalis at first being green and soon changing to dark brown.

A large number of larvæ, mostly in the final larval instar, were collected May 8 and 9 and placed in a jar. Each day this jar was inspected and the pupæ that had transformed were removed to separate glass vials, over the mouths of which cheese-cloth was stretched in order to allow of free passage of air. Out of 102 pupæ obtained, 25 perished before reaching the adult stage. No parasites issued from these twenty-five. In the field, especially towards the end of the pupal period, a fair percentage of the pupæ were parasitized. Of the 77 adult moths which issued, 47 were females and 29 males, the remaining individual escaping before its sex could be ascertained. The total average pupal period was 19.9 days, the length of the stage varying from 16 to 23 days. The average pupal period for the 47 females was 19.8 days and for the 29 males 20.3 days. In Colorado in 1912 Gill[2] found that the pupal stage occupied on the average 11.25 days and covered a period from May 28, until the last week in June. He records [3] that the maximum period of pupation was reached from about June 12 to June 20, and that pupæ could be found in the field as late as July 10. In California the writer found that the maximum pupation period took place in the field about May 20, and that live pupæ could be found as early as April 24, and as late as July 1.

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[1] Published with the permission of the Chief of the Bureau of Entomology.

[2] Gill, "The Fruit-tree Leaf-roller"; U. S. Dept. Agr. Bur. Ent. Bull. 116, pt. 5, p. 98.

[3] Ibid. p. 99.

RECORDS OF THE PUPAL INSTAR, SAN JOSE, CAL., 1911

No. individual	Date of pupation	Date of adult emergence	Pupal period days	Sex of moth
1	May 8	May 31	23	Female
2	9	26	17	Male
3	13	June 2	20	Female
4	13	2	20	Female
5	13	2	20	Male
6	13	3	21	Female
7	13	3	21	Female
8	13	4	22	Male
9	13	5	23	Male
10	13	5	23	Female
11	13	5	23	Female
12	14	2	19	Female
13	14	4	21	Female
14	14	4	21	Male
15	14	4	21	Male
16	14	5	22	Male
17	14	5	22	Male
18	15	3	19	Male
19	15	4	20	Female
20	15	4	20	Female
21	15	4	20	Female
22	16	5	20	Male
23	16	5	20	Male
24	16	5	20	Female
25	16	6	21	Female
26	16	6	21	Male
27	16	8	23	Not known
28	17	4	18	Female
29	17	4	18	Female
30	17	4	18	Female
31	17	5	19	Female
32	17	5	19	Female
33	17	6	20	Female
34	17	6	20	Male
35	17	8	22	Female
36	17	8	22	Female
37	18	5	18	Female
38	18	5	18	Female
39	19	6	18	Female
40	19	6	18	Female
41	19	7	19	Female
42	19	7	19	Female
43	19	8	20	Female
44	19	8	20	Male
45	19	11	23	Female
46	20	5	16	Female
47	20	5	16	Female
48	20	6	17	Male
49	20	6	17	Male
50	20	7	18	Male
51	20	8	19	Female
52	20	8	19	Female
53	20	8	19	Female

RECORDS OF THE PUPAL INSTAR—*Concluded*

No. individual	Date of pupation	Date of adult emergence	Pupal period days	Sex of moth
54	May 20	June 10	21	Female
55	20	11	22	Male
56	20	12	23	Male
57	20	12	23	Female
58	21	8	18	Male
59	21	8	18	Male
60	21	8	18	Female
61	21	8	18	Male
62	21	10	20	Male
63	21	11	21	Male
64	21	11	21	Male
65	21	11	21	Male
66	21	11	21	Female
67	22	10	19	Female
68	22	10	19	Male
69	22	11	20	Male
70	22	11	20	Male
71	22	11	20	Female
72	22	11	20	Female
73	23	11	19	Female
74	23	12	20	Female
75	24	14	21	Female
76	27	15	19	Female
77	June 1	19	18	Female

Gillette and Weldon [4] state that the pupal stage occupies about ten days in the vicinity of Canon City, Colo.

It appears thus that the larvæ pupate on the average nearly a month earlier in California than in Colorado and that the pupal instar occupies almost double the number of days in the former state as in the latter. The first of these phenomena is to be expected when it is considered that larvæ hatch from the winter eggs much earlier in California than in Colorado, Gill [5] in his paper stating that "During the season of 1912, in the orchards, the eggs were hatching from April 20 to May 9, . . ." A comparison of the meteorological conditions influencing respectively Colorado and California pupæ might explain the difference in the length of the instar in the two localities.

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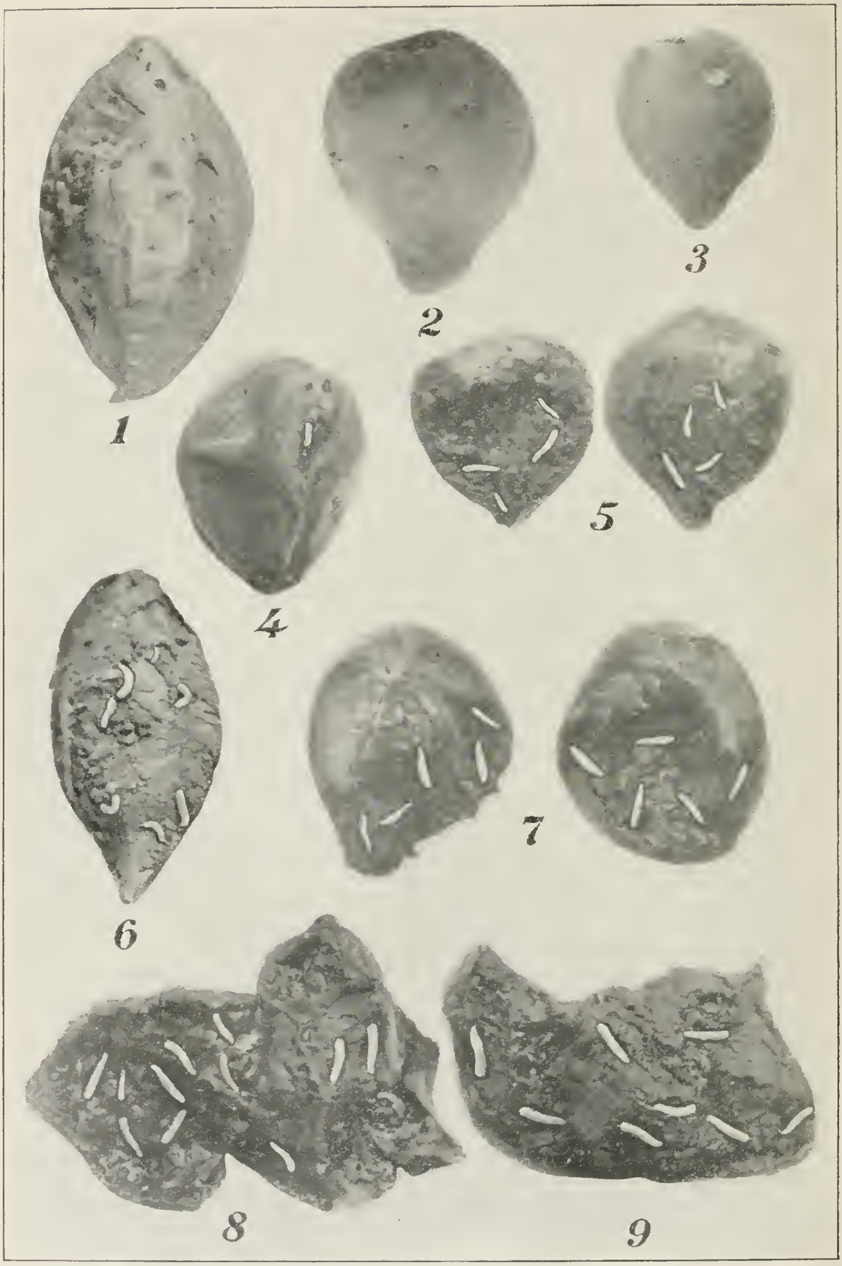
[4] Gillette and Weldon, "The Fruit-tree Leaf-roller in Colorado," Colo. Agr. Exp. Sta. Circ. 5, p. 6.

[5] U. S. Dept. Agr. Bull. 116, pt. 5, p. 102.



Mediterranean Fruit Fly

THE LIFE HISTORY OF THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.) WITH A LIST OF FRUITS ATTACKED IN THE HAWAIIAN ISLANDS

By Henry H. P. Severin, Ph. D.

The life history of the Mediterranean fruit fly under Hawaiian conditions was worked out in the tropical almonds (*Terminalia cattapa*). The tropical almond is a very common deciduous shade tree of the Hawaiian Islands and bears clusters of compressed nut-like fruits, each fruit being one to two inches long and resembling an almond (Plate 9, figure 1). The fibrous shell of the nut is covered with a thin pulp (Plate 9, figure 6) and it is this pulp that is seriously infested by the pest. The pulp of the fruit is sweet and resembles somewhat the taste of an apple.

Deposition of Eggs.—In ovipositing the Mediterranean fruit fly "stings" the fruit with its needle-like ovipositor, forming a small receptacle within which the eggs are deposited. A secretion is then poured over the eggs by the fly and this acts on the surrounding tissue, changing it into a brown gelatinous substance. This gelatinous substance often exudes out of the mouth of the receptacle and hardens. Green peaches that have been punctured by the pest show the gummy exudation (Plate 9, figure 3) more conspicuously than tropical almonds similarly affected. Green and ripe lemons may also show evidence of a resinous material which exuded from the wound produced by the ovipositor. Green oranges when "stung" often show a premature ripening around the puncture. In some unripe fruits the secretion poured into the receptacle formed by the female fly prevents further growth of the tissue in this region, and results in the formation of a depression on the surface of the fruit. (Plates 9, 10, figures 1, 2 and 10).

The number of eggs which the fruit fly deposits within the receptacle varies from 1 to 42. Five receptacles within a tropical almond contained 15, 18, 30, 33 and 42 eggs, or a total of 138 eggs. The pulp of the tropical almond and other fruits is often punctured by the ovipositor and yet no eggs are deposited.

The fruit fly is unable at times to withdraw its ovipositor from some fruits. An unripe tropical almond was found in which the distal end of an extended ovipositor was caught within the fibrous shell of the nut, while the rest of the body was missing. In all probability the missing part of the body of this specimen had been devoured by a lizard. The female fly is often unable to withdraw its ovipositor from the sticky, milky juice of the unripe star apple and dies as a result of starvation (Plate 10, figure 14).

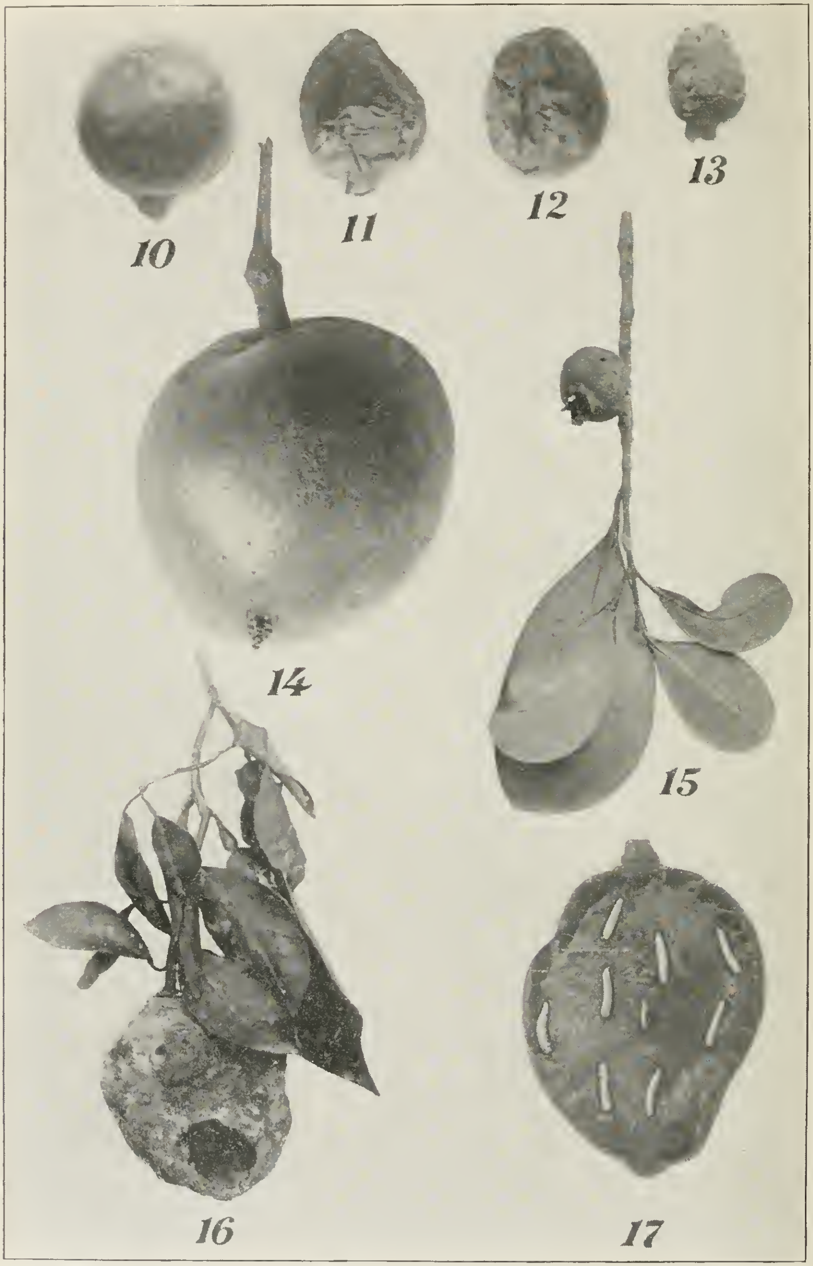
When the eggs are deposited within the pulp of ripe tropical almonds they hatch in from 2 to 3 days but when deposited in green fruits the egg period is often somewhat prolonged.

Larvæ.—Eggs deposited in some green fruits either do not develop or the recently hatched larvæ perish apparently from the effects of the strong acid pulp of the fruit. The larvæ, however, are able to develop in unripe tropical almonds and peaches. Concerning the development of the eggs and larvæ in green Chinese bananas we (4, p. 446) found that of 100 eggs planted within the peel 69 hatched, but all of the maggots died, probably from the effects of the tannic acid. Many eggs deposited in green and ripe lemons (*Citrus medica limonum*) hatched but in our observations all of the maggots died. French (2, p. 3) of Victoria and Mally (3, p. 5) of South Africa have both, however, succeeded in breeding the Mediterranean fruit fly from lemons. Whether the maggots of this pest are able to complete their larval development in certain varieties of lemons and not in others will require further investigation.

The larvæ work their way into the pulp of the fruit, which soon begins to decay (Plate 9, figures 5, 6, 7, 8 and 9) and the fruit usually drops to the ground. On rare occasions the dried and shriveled fruit will remain adhering to the trees after all of the larvæ have burrowed out (Plate 10, figures 15 and 16). It may happen that some of the maggots will bore out of the fruit before the same drops to the ground.

The larvæ remain in the tropical almond from 8 to 17 days after which they bore out and enter the ground to pupate. The rate of development of the maggots probably depends on many factors, such as temperature, moisture, the kind, ripeness, hardness, decay, dryness, and acidity of the fruit.

Data were desired concerning the number of Mediterranean fruit fly larvæ which may be found infesting tropical almonds. Accordingly, 25 infested tropical almonds were gathered at random from a tree and placed in 25 breeding jars. In two weeks a total of 1037 fruit fly maggots had bored out of the pulp of these fruits. Each tropical almond was now immersed in water so as to drown out any larvæ which might still be present in the pulp or fibrous shell of the nut. With the addition of a small quantity of alcohol to the water the maggots leave the fruit more rapidly and within five hours 341 immature fruit fly larvæ burrowed out of the decayed pulp. The pulp of each fruit was now carefully removed and two maggots were found within the fibrous shell. The total number of full grown and immature larvæ obtained from 25 tropical almonds was 1380. The largest number of full grown maggots obtained from a single tropical almond was 98, of these 60 were full grown and 38 immature. One would be inclined to believe that



Mediterranean Fruit Fly

with so many maggots present, some would not obtain a sufficient food supply from the small amount of pulp surrounding the seed. The largest number of adult fruit flies bred from a single tropical almond was 28 males and 32 females, a total of 60 flies; some of these specimens were much smaller than others, but we did not determine whether these were able to deposit eggs.

In another experiment 12 infested tropical almonds were placed in separate breeding jars and exposed to hot sunshine. At the end of a week the pulp of these fruits became hard and leathery. From two of these fruits 19 larvæ bored out, 7 of which died in the bottom of the jars and 12 pupated, but the pupæ failed to give rise to imagoes. A field observation along this same line may be worth recording. An orange that had been exposed to hot sunshine was found on the ground and upon opening this fruit three dead Mediterranean fruit fly larvæ were found. These maggots were black or brown in color and suggested that death had been due to a bacterial or fungus disease. Mally (3, p. 10) also observed many dead larvæ in the fallen fruits of *Citrus buxifolius* and concluded that after several days of very hot weather the fruit "became sufficiently hot to destroy the contained maggots."

PUPÆ.—After the larvæ leave the fruit they bore into the ground to pupate. Rarely under normal conditions do the maggots pupate within the fruit, but a few pupæ have been found in the pulp of the tropical almond and orange. The pupal period requires from 15 to 17 days, before the adults emerge.

ADULT.—Dreyer of South Africa (1) writes: "It is well known that when the flies appear on the wing their eggs are undeveloped and require, in order to be brought to maturity and made ready for laying, a period of about 10 to 12 days during which the flies subsist on saccharine substances." An attempt was made to determine the length of this period under Hawaiian conditions. A large number of fruit flies were kept in captivity in breeding jars and fed on dilute molasses, the juice of orange, prickly pear and on water. After having been kept in captivity for 8 days, three females were dissected but no fully developed eggs were found in the ovaries. Daily dissections of three females were continued from now on and ripe eggs were found in one fly at the end of 11 days but other females did not show mature eggs in the ovaries at the end of 14 days. In all probability the effect of confining the fruit flies in breeding jars plays an important part in the rate of development of the reproductive organs.

The duration of the different stages of the life history of the Mediterranean fruit fly may be summarized as follows:

Egg period	2 to 3 days.
Larval period	8 to 17 days.
Pupal period	15 to 17 days.
Egg-laying begins	10 to 12 days after the adults emerge (Dreyer).
" "	35 to 49 days.
" "	5 to 7 weeks.

Miss L. Gulick and the writer have bred the Mediterranean fruit fly from a long list of fruits in the Hawaiian Islands. Since the common names by which these fruits are known in the Hawaiian Islands may be entirely different in other parts of the world we give in the following list not only the common names but also the scientific names of these fruits, basing the latter on the authority of G. P. Wilder's (5) work on "Fruits of the Hawaiian Islands."

1. Anona muricata (sour sop).
2. Arenga saccharifera (sugar palm).
3. Averrhoa carambola (carambola).
4. Carica papaya (papaia).
5. Carica quercifolia (baby papaia).
6. Carissa ardiuna (Natal plum).
7. Cestrum sp? (Chinese ink berry).
8. Chrysophyllum cainito (star apple).
9. Chrysophyllum oliviforme (Damson plum).
10. Citrus aurantium (Bahia, or Washington navel orange).
11. Citrus aurantium sinense (Waialua orange).
12. Citrus decumana (grapefruit).
13. Citrus japonica (kumquat).
14. Citrus japonica "hazara" (Chinese orange).
15. Citrus medica limetta (lime).
16. Citrus nobilis (Mandarin orange).
17. Coffea liberica (Liberian coffee).
18. Diospyros decandra (brown persimmon).
19. Eriobotrya japonica (loquat.).
20. Eugenia jambos (rose apple).
21. Eugenia uniflora (French cherry).
22. Ficus carica (fig).
23. Jambosa malaccensis (mountain apple).
24. Mangifera indica (mango).
25. Mimusops elengi (elengi tree).
26. Murraya exotica (mock orange).
27. Musa cavendishii (Chinese banana).
28. Noronhia emarginata (Chinese plum).
29. Opuntia tuna (prickly pear).
30. Persea gratissima (avocado or alligator pear).
31. Prunus persica (peach).
32. Psidium cattleyanum (strawberry guava).
33. Psidium guayava (sweet red guava).
34. Psidium guayava (white lemon guava).
35. Psidium guayava pomiferum (common guava).
36. Thevetia nerifolia (yellow oleanda).
37. Terminalia cattapa (tropical almond called "kamani" by the Hawaiians).
38. Vitus labrusca ("Isabella grape").

The pest has also been bred from green peppers. Squash and string beans are also said to be attacked by the insect.

A few fruits kept under observation were found to be immune from the attacks of Mediterranean fruit fly under natural conditions. The following list is by no means complete:

1. Artocarpus incisa (bread fruit).
2. Citrus medica var., limonum (roughskin lemon).
3. Morinda citrifolia ("noni").
4. Morus nigra (mulberry).
5. Punica granatum (pomegranate).
6. Tamarindus indica (tamarind).

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EXPLANATION OF PLATE 9.

Fig. 1. Tropical almond showing depressions caused by the oviposition of the Mediterranean fruit fly.

Fig. 2. Peach showing similar depressions.

Fig. 3. Green peach showing gummy exudation which often exudes from the wound caused by the ovipositor.

Fig. 4. Peach with collapsing peel due to decay of the pulp brought about by larvæ of the Mediterranean fruit flies.

Figs. 5 and 7. Peaches cut in half showing decay and fruit fly maggots.

Fig. 6. Tropical almond with peel removed showing the Mediterranean fruit fly larvæ and thickness of pulp.

Figs. 8 and 9. Peaches broken open showing more advanced stages of decay and larvæ.

EXPLANATION OF PLATE 10.

Fig. 10. Strawberry guava showing depressions.

Figs. 11, 12, and 13. Strawberry guavas showing different stages of decay caused by the larvæ of the Mediterranean fruit flies.

Fig. 14. Dried and shriveled strawberry guava still adhering to a twig after all of the Mediterranean fruit fly larvæ have bored out. The infested fruit, however, usually drops to the ground before the maggots bore out.

Fig. 15. Unripe star apple showing dead Mediterranean fruit fly which was unable to withdraw its ovipositor from the sticky, milky juice of this fruit.

Fig. 16. Dried navel orange still adhering to the twig and showing a hole through which the fruit fly larvæ and decayed pulp dropped out. After the Mediterranean fruit fly larvæ caused this orange to decay, the black and the brown fruit beetles and their grubs and Drosphilid larvæ also infested this orange.

Fig. 17. Mango with peel removed showing decay and maggots.

NOTES ON OREGON COCCINELLIDÆ

By H. E. Ewing
Oregon Agricultural College, Corvallis, Oregon

For almost two years the writer has taken field notes on the more common species of Coccinellidæ found in Oregon. Several experiments also have been made with them in the laboratory in order to test their fecundity, the stability of varieties, and the economic value of the different forms. From these field notes and laboratory records the following account has been prepared.

Relative Economic Importance of Different Species Found in Oregon

The most abundant and the most important species of Coccinellidæ found in Oregon is *Hippodamia convergens* Guérin. It is found everywhere in the lower altitudes of western Oregon in the spring and summer, and in the higher altitudes during the fall and winter. It is found in eastern Oregon, but may not have a general distribution there.

The next most abundant and most important species found here is *Hippodamia spuria* Leconte. During the month of September, 1912, I collected a hibernating mass of this species, found in company with *H. convergens* Guérin, from the top of Mt. Chintimini (about 4000 ft.). Out of 256 individuals obtained, 64 were *H. spuria* Leconte and 192 were *H. convergens* Guérin. This is about the average ratio of the two species as found during the summer time feeding in the valley. Next in abundance, but probably not in importance is *Coccinella novemnotata* Herbst. Then comes perhaps *Chilocorus bivulnerus* Muls. and *Cycloneda sanguinea* Linn. While these two latter species are not so abundant as *Coccinella novemnotata* Herbst., their activities are directed against more serious pests. *Psyllobora tædata* Leconte appears to be the most abundant species found among the foothills and mountains in the summer. It is not of special economic importance as yet as it seldom is found in the valleys on cultivated plants. *Smilia misella* Leconte is present in the Willamette Valley, and does good work against the San Jose Scale. *Adalia bipunctata* Linn., *Hippodamia parenthesis* Say, and *Coccinella transversoguttata* Fald. are present in considerable numbers, but never are of prime importance.

Migration and Hibernation Habits

Late in July or early in August many of our most common coccinellids run short of aphid food, and for a while will be found in great

numbers feeding upon the pollen of various plants. In searching for such food, there frequently is a tendency for large numbers to move in certain directions or to collect upon certain very much desired flowers. However, there does not appear to be any fixed migration accompanied by such gregarious habits as are found for example in the case of some of the species of blister beetles, Meloidæ.

By the middle of August (which here is the hottest and dryest part of the year) the coccinellids begin a definite migration. They, almost of one accord, quit the hot dry valleys and move upward, many of them never stopping until the highest point for miles around is attained. Thus, last September I found thousands of them on the very summit of Mt. Chintimini, the highest point in the Coast Range Mountains. Here in these higher altitudes the coccinellids move about and swarm many times. As soon as winter has set in they have settled in their permanent hibernating quarters. These consist of pockets under large stones, rubbish, or under leaves or logs. There is a strong tendency for the different species and varieties to segregate themselves in their winter quarters. Thus in many pockets of *Hippodamia convergens* Guérin will be found all or over 90 per cent of the typical form, *i. e.*, the form with thirteen spots on the elytra. Other pockets will contain individuals all or the most of which are spotless forms of *H. convergens* Guérin. I have found that there is sometimes a mixing of species in the hibernating quarters, thus frequently a few individuals of *H. spuria* Leconte will be found with *H. convergens* Guérin and vice versa.

The coccinellids pass the winter without food, and are, for long periods at least, perfectly quiescent. That some of our species can pass the winter hibernating at the lower levels I have proved by experments, the mortality, however, is very great unless they are kept in artificially cooled quarters.

Emergence of Adults in Spring

There is some variation among the different species in regard to the time of emergence in the spring. At Corvallis, a valley town 230 feet above sea level, I have the following records for the spring of 1913. The dates given represent the first recorded observation of an active individual out of doors:

Chilocorus bivulnerus Muls........................February 10.
Hippodamia convergens Guérin (spotless form)............April 11.
Adalia bipunctata Linn...............................April 14.
Hippodamia convergens Guérin (typically marked).........April 16.
Hippodamia convergens Guérin (with some spots)..........April 17.

Hippodamia spuria Leconte............................April 21.
Coccinella novemnotata Hbst..........................April 21.
Coccinella transversoguttata Fald....................April 21.

By the time that most of these coccinellids reach the valleys, *i. e.*, by the middle of April, an abundance of aphid food is present. Our most common aphids hatch in early March, and by the middle of April most of these individuals are mature.

However, this supply of food is cut short by about the middle of May, due not only to the voracious appetites of the lately emerged coccinellids, but to other enemies also, the most important of which are syrphis fly larvæ and a lampyrid beetle, *Podabrus prinosus* Leconte.

Again the coccinellids must rely upon plants for most of their food. By the first of June, thousands of individuals will be found in vetch fields and among wild flowers along the road sides or in turning rows. Around Corvallis, nearly all of the common species go to the vetch fields. Here they feed upon a cell sap or nectar secreted by special glands, one of which is located on each stipule situated at the base of a compound leaf.

Miscellaneous Notes and Observations

There is a distinct preference shown by our most common coccinellids for certain species of *Aphididæ*. Among those most sought are: The Black Cherry Aphis (*Myzus cerasi* Fab.), Snow-ball Aphis (*Aphis viburni* Scopoli), Rosy Apple Aphis (*Aphis sorbi* Kalt.), and European Grain Aphis (*Aphis avenæ* Fab.).

On the other hand, such aphids as the Green Apple Aphis (*Aphis pomi* DeGeer) and the Woolly Apple Aphis (*Eriosoma lanigera* Haus.) are not relished with nearly as much zest as the former mentioned plant lice. In fact some of our common coccinellids will not live alone upon a diet of *Aphis pomi* DeGeer. This I have demonstrated in the laboratory.

Among the records of some of the rarer species of coccinellids, I have to report a single observation of *Anisocalvia duodecimmaculata* Gebl., a female, and of *Anisocalvia quatuordecimguttata* Linn., a male. These two were found in copulation, on leaves of vine maple, at Corvallis, May 2, 1913, by G. Moznette.

Before closing I will add a single synonymical note. I am of the opinion that the typically marked form of *Hippodamia convergens* Guérin and the spotless form should be regarded as distinct species, as they were once, for the following reasons:

1. I find the spotless form breeds true to type.
2. The two forms have a tendency to segregate themselves in their

hibernating quarters and during their breeding season early in the spring. Thus, out of a hibernating mass collected March 9, 1913, at Sulphur Springs, Benton Co., by F. D. Bailey, containing 367 individuals, 344 were typically marked while only two were spotless. Out of 552 individuals collected at Carlton, during March, 1913, 500 were typically marked; only 5 were spotless. Out of 33 individuals found under bands on seven year old cherry trees May 15, 1913, 30 were spotless, 1 was typically marked.

3. The fact that the two are found intergenerating should not affect their specific status, for frequently intergeneration takes place in nature between different species of Coccinellidæ.

NOTES ON THE NEGATIVE GEOTROPISM OF CORYTHUCA CILIATA SAY, ADALIA BIPUNCTATA LINN, COCCINELLA 9-NOTATA HBST AND MEGILLA FUSCILABRIS MULS.

By Harry B. Weiss, *New Brunswick, N. J.*

Corythuca ciliata Say. Upon placing hibernating specimens of this "lace bug" in a glass cage in a warm room, their re-actions to gravity were manifested in a rather curious way. When the temperature in the cage rose sufficiently, all became active and possessed of a desire to climb vertical surfaces. Small sticks placed vertically in the cage were soon covered with individuals going up and those unable to gain a foothold on the sticks, climbed upon the backs of others and made their ascent in this manner, until the sticks were covered with one seething mass of insects.

Those on the bottom of the jar re-acted somewhat differently. One individual meeting another, would climb upon its back and a third happening along would climb upon the back of the second and a fourth and fifth would do the same, until a regular tower of "lace bugs" was formed. As a rule, when the sixth attempted to climb up, the tower would sway, finally topple and all would come down. If the first happened to be resting at an angle on the edge of a piece of bark, the tower would extend out over the edge in an extremely perilous position and usually collapsed when the fourth attempted to climb out.

In most of the cases, the last one up, would fly off in the same manner that a "lady bird" walks upward on a twig, until the top is reached and then flies off, provided it finds no plant lice.

In the bottom of the cage were several pieces of bark and the insects always preferred walking on edges or ridges that pointed upward.

This negative geotropic response took place in the dark as well as in the light, provided the temperature was high enough. Rays of

light thrown upon different parts of the cage, produced no responses, the insects in all cases adhering to their geotropic re-actions.

Adalia bipunctata, Coccinella 9-notata and *Megilla fuscilabris.* In order to determine the distance over which a Coccinellid would travel during a negative geotropic response in the absence of food, specimens of *Adalia bipunctata* were taken while feeding, kept for five hours without food and then placed on the bottom of a fifteen foot vertical stick. The following table shows the distances travelled by ten different beetles. The stick was placed out of doors in the shade, the temperature being 70° F.

The length of time, from the start until they flew away was also noted and this varies considerably, many of the beetles resting for comparatively long periods.

ADALIA BIPUNCTATA LINN.

Shade, Temperature 70° F.

A	8 feet,	2 inches,	18 minutes
B	13 feet,	1 inch,	10 minutes
C	6 feet,	2 inches,	11 minutes
D	13 feet,	6 inches,	30 minutes
E	4 feet,	4 inches,	8 minutes
F	10 feet,	3 inches,	15 minutes
G	3 feet,	6 inches,	12 minutes
H	11 feet,	1 inch,	12 minutes
I	6 feet,	6 inches,	8 minutes
J	9 feet,	2 inches,	18 minutes

The average distance covered comes to a little over eight feet and in no case was the top of the stick reached.

The following table gives the distances covered by *Coccinella 9-notata*, both in the sunlight and shade.

COCCINELLA 9—NOTATA HBST.

Sunlight, Temperature 83° F.				Shade, Temperature, 75° F.			
A	1 foot,	9 inches,	3 minutes	A	9 feet,	2 inches,	6 minutes
B		6 inches	1 minute	B	8 feet,		8 minutes
C	1 foot,	6 inches,	2 minutes	C		3 inches,	1 minute
D	1 foot,	1 inch,	3 minutes	D	11 feet,		4 minutes
E	1 foot,	4 inches,	2 minutes	E	8 feet,		7 minutes
F		10 inches,	4 minutes	F	8 feet,	9 inches,	10 minutes
G		5 inches,	2 minutes	G	8 feet,		3 minutes
H	2 feet,	9 inches,	1 minute	H	7 feet,		4 minutes

These Coccinellidæ were taken while feeding and kept two hours without food. With this species, the average distance in the sunlight is 1 foot, 3 inches and 7 feet, 6 inches in the shade.

The next table is for *Megilla fuscilabris* Muls. These individuals were also taken while feeding and kept one hour without food.

Megilla fuscilabris Muls.

Sunlight, Temperature 89° F.				Shade, Temperature 75° F.			
A		5 inches,	5 seconds	A	12 feet,	1 inch,	9 minutes
B		6 inches,	5 seconds	B		6 inches,	$5\frac{1}{2}$ minutes
C		3 inches,	4 seconds	C	17 feet,		7 minutes
D		5 inches,	4 seconds	D		4 inches,	5 seconds
E	7 feet,		2 minutes	E	8 feet,	2 inches,	8 minutes
F		3 inches,	4 seconds	F	1 foot,	7 inches,	4 minutes
G		8 inches,	3 seconds	G	9 feet,		5 minutes

The averages for this species are 1 foot, 4 inches in the sunlight and 7 feet in the shade. Individuals which had climbed three or four feet in the shade after being moved to the sunlight, continued only a few inches more and then flew off. Of the three species, *Megilla fuscilabris* was the most active, being seemingly possessed of a nervous irritability.

All of the beetles were handled as little as possible and used only once.

The tables show that the length of time and especially the distance covered, were considerably shortened when the re-actions took place in sunlight and while the temperature was higher, yet beetles moved from the shade to sunlight flew away almost before they could have become sensible to the higher temperature.

Plant lice of course are usually found in shaded situations such as the undersides of leaves and Coccinellidæ undoubtedly hunt longer and over a greater distance in such situations.

It seems fair to conclude then, that other factors being equal, sunlight and possibly high temperatures shorten the distance covered during a geotropic response and also the time during which the beetle responds to such stimuli, thereby giving the beetle a greater chance to find food. Sunlight does not, however, influence the direction of locomotion or the negative geotropic position assumed by the beetle.

NOTES ON GYPONA OCTOLINEATA SAY

(Hemiptera, Jassidæ)

By R. L. Webster

Not much concerning this common leaf-hopper, sometimes known as the "eight lined Gypona," appears in entomological literature. Outside of some observations by Fitch (1867) and later by Osborn and Ball (1897), very little has been written. While of no great economic importance, this species, with other leaf-hoppers, no doubt causes considerable injury in grass lands, as suggested by Osborn and

Ball. As Fitch has said, however, the insects feed in a great variety of situations, with apparently little preference.

Occasional observations on this insect have been made by the writer in Iowa, and some new things have been learned. For that reason these notes are presented for publication, together with records of other writers, bringing so far as possible the knowledge of this species up to date. These notes are from the files of the entomological section of the Iowa Agricultural Experiment station at Ames.

Past History. This species was first described by Say (1825), who gave it the name *Tettigonia octolineata.* Subsequently it was placed in the genus *Gypona.* Fitch (1851) described *Gypona flavilineata,* but Osborn and Ball (1897) consider that Fitch's species is only a variety of *octolineata* Say.

Distribution. Doctor Forbes has given as the distribution of this insect: Eastern United States, Canada to Texas. Van Duzee records the variety *flavilineata* collected by W. J. Palmer near Lake Temagami, Ontario. Lugger mentions the species as occurring in Minnesota and Uhler records it in Colorado.

Food Plants. Any list of the food plants of this ubiquitous species is necessarily incomplete, on account of its adaptability to so many different plants. Fitch listed the following: Dahlia, aster, oak, walnut, beech, maple, birch, willow and dogwood. Other records are blackberry (Lugger) and sugar beet (Forbes). Osborn and Ball found that the insect "occurred upon the wild grasses of woodlands especially." In the insectary at Ames the nymphs and adults lived on apple shoots readily.

Life History. *Generations.* Osborn and Ball (1897) have shown that there are in Iowa two generations of this insect. In 1909 in the insectary two generations were observed, for second brood nymphs were reared from eggs deposited by first brood adults. The insect winters in the egg stage and the eggs are placed singly in small pouches in the bark of apple and probably of other trees.

Osborn and Ball said that the first brood nymphs (half to full grown) were abundant in Iowa from mid-June to mid-July; the adults from the first of July to the middle of August. The writer's records are generally earlier than these dates. Practically all of the notes of the writer refer to the first generation.

According to Osborn and Ball the second brood larvæ appear in late August and September; the adults in September and October.

The adults of the first generation are of the *flavilineata* type, while those of the second are usually of the *octolineata* type, according to the observations of Osborn and Ball. The adults (all first brood) reared in the insectary by the writer, were all of the *flavilineata* type.

The Egg. Eggs of this species were found deposited in the bark of young apple trees, as the following notes from insectary records show.

In the spring of 1909 a number of young Jonathan apple trees, sent from Shenandoah, Iowa, were set out in the insectary for experimental use. In the bark of one of these trees were two egg pouches, similar to those figured by Riley (1892) as egg pouches of the Membracid, *Ceresa taurina* Fitch. These two eggs hatched, but the nymphs were overlooked until May 31, when they were over half grown. Some of these same nymphs were found on other young Jonathan trees in the insectary at this time. The two nymphs from the one tree were kept in a separate cage on a young apple tree, and on June 9 they became adult. The two happened to be male and female, and were found in copulation at this time. The species was then determined as *Gypona octolineata*, variety *flavilineata*.

On June 15 in this cage I found a single egg deposited openly on a leaf, and also a number of egg slits in the bark of the young apple tree. The single egg in the open was apparently accidentally deposited there. This egg was cylindrical, white, 1.63 mm. long and .32 mm. broad. One end of the egg was slightly more rotund that the other, which tapered a little more.

These egg slits were, of course, similar to those in the apple bark from which the parent Jassids had come. On subsequent days in this cage more eggs were deposited, until 34 in all were counted in the bark. These eggs were placed usually at random over the bark; in one instance four were placed in a row, one below the other, and slightly to the left. These last apparently were deposited at one time.

On July 3, 18 days after the eggs were first seen, the young nymphs appeared in this cage. These nymphs lived for about two weeks, but finally all of them died, apparently having been killed by some spiders that had gotten into the cage.

At Shenandoah in the spring of 1908, and again in 1909, I noticed egg pouches similar to those described above, in apple nursery stock in some abundance. This was in the same nursery from which the young Jonathan trees, previously mentioned, had come. The same kind of eggs were also common on Carolina poplar nursery trees, where from 6 to 12 punctures in a row were often found, although from 6 to 9 was the usual number.

These eggs found at Shenandoah were like those deposited in the apple bark in the insectary, except that there was a black mark present on the egg at the slit. This mark shows on the egg itself, after being dissected from the bark, as well as through the slit in its normal position. In the eggs deposited in the insectary cage in June, these black

marks were not found. I think, however, that both kinds were made by the same species.

Twice I have run across eggs of this kind in the skin of apples, once in 1908 and again in 1909. In 1909 (Journ. Econ. Ent.) I described the eggs found the fall before, referring them doubtfully to *Ceresa taurina* Fitch. The work of Hodgkiss (1910), however, has shown that the eggs of *Ceresa taurina* are placed in a quite different situation, and my more recent observations show that the eggs of *Gypona octolineata* are similar to, and probably the same as, the eggs found in the skin of the apple.

No blackened portion of the egg is mentioned in my notes of November, 1908, but in November, 1909, when similar eggs were found in a Ben Davis apple, the black mark on the egg at the slit was quite distinct.

Jassid eggs of this description have been referred to two species of Membracids, first to *Ceresa bubalus* Fabr., by Riley (1873) and later by the same writer (1892) to *Ceresa taurina* Fitch. Hodgkiss (1910) has shown that the eggs of *Ceresa taurina* are deposited in the buds of apple trees, and refers the egg pouches figured by Riley to some of the large leaf-hoppers, naming *Gypona cana* Burm., and *Gypona octolineata* Say.

An excellent illustration of these eggs may be found in the *Pennsylvania Zoölogical Bulletin*, vol. 5. No. 3. plate ix., drawn by W. R. Walton. Here the eggs are wrongly referred to *Ceresa bubalus*, in spite of Riley's later correction (1892).

The Nymphs. I have twice observed nymphs hatching from eggs which were probably of this species. At any rate I could not distinguish any differences that would separate them. At Shenandoah May 10, 1909, I found a nymph just emerging from an egg deposited in the bark of a Carolina poplar tree. Again at Burlington, Iowa, April 15, 1910 (a very early spring) I found a nymph emerging from an egg placed in the bark of a crabapple tree. These nymphs were both pale orange in color, with long antennæ, reaching beyond the tip of the abdomen. They were also pale along the median dorsal line.

The following description of the larva is taken from Osborn and Ball. "The larvæ very strongly resemble the adults. The head is abruptly narrowed in front of the eyes but projected centrally. The antennæ are very long, the basal joint nearly as long as the vertex, while the bristle reaches to the middle of the abdomen. The abdomen is long, rather slender, color green."

In the insectary cages the larvæ were found usually feeding along the green stems of apple twigs, or in the axils of the leaves.

The Adults. I can add nothing to previous accounts concerning the adult insects.

Work of Cryptothrips on Orange

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AN UNUSUAL TYPE OF INJURY DUE TO A THRIPS

By J. R. Watson, *Gainesville, Fla.*

In the Entomological News for February, 1912, the writer described an apparently new species of thrips (*Cryptothrips floridensis*), which was attacking camphor trees on the extensive plantation of the Satsuma Company at Satsuma, Florida. Since then some additional studies and a personal inspection of the work of the insect in the field have been made. These studies have discovered a type of injury so unusual for a thrip as to suggest that it might not be without interest to the readers of the Journal of Economic Entomology.

In the beginning of the infestation of the camphor tree, the eggs are laid between the scales of the terminal bud. If the bud has commenced to develop when the eggs hatch, the larvæ first attack the new growth. If there are but a few of the larvæ on each bud, there will result a blackening and deforming of one side of the young leaves (Plate 11, figure 1). If there are more of the larvæ, the developing bud will be killed outright, (Plate 11, figure 2). The insects then attack the younger twigs where they feed in groups, the yellow larvæ

being very conspicuous on the light green shoots of the camphor. The bark where these groups of larvæ feed is killed (Plate 11, figure 3), and, as it dries out, it cracks (Plate 11, figure 4). The adults use these cracks as hiding places and as a means of entrance to the cambium on which they lay their eggs. As the infestation proceeds the bark on all of the twigs is killed and the leaves are shed. This leaves the cambium as the only suitable breeding place, and here the larvæ as well as the adults are to be found. A favorite feeding place is at the base of a branch. This is quickly killed and then easily broken off, leaving a scar much like the one at the base of a petiole only larger and deeper (Plate 11, figure 5). They also gain access to the cambium at the cut ends of the twigs after the trees have been pruned to supply material for distillation. The Cryptothrips continue to work on the cambium until the whole plant is killed. The insect seems to be incapable of flight, although it has well developed wings. It probably spreads from one plant to another by means of workmen and horses which brush against the plants during cultivation, and by crawling over the ground, leastwise it spreads in all directions from the center of infestation, but most readily along the rows, where the distance between the plants is less than that across the rows. It kills every plant in its onward march, although it may temporarily skip one to attack those beyond.

It was found on large trees at Satsuma, near Palatka, and at Tampa, but seems to do very little harm to them. It is the young seedlings in the nursery row and the young trees in the field that are killed. The writer has been unable to find this insect about Jacksonville, Gainesville, or other towns in north Florida. This raises the question of its origin. The camphor is not a native of Florida. Is this insect a native species which has spread to the camphor, or has it been imported with camphor? The writer will be very grateful if entomologists located where the camphor trees grow will send him specimens of any black (larval yellow) thrips found on this tree.

Tobacco decoctions kill them, but it has been found necessary to make them stronger than for most species. For the adults a solution composed of a half gallon of whale oil soap, one half gallon of commercial lime sulphur, and a half pound of Black Leaf 40 to fifty gallons of water is now in use. This has proven quite efficient. It does not, however, kill the eggs and of course all the adults and larvæ hidden under the bark escape. By spraying not later than the stage represented in figure 3 when the larvæ are mostly in the buds or on the outside of the twigs, and by cutting out the trees in the later stages of infestation, it was found possible to control this pest.

THE GASOLINE TORCH TREATMENT OF DATE PALM SCALES

By R. H. Forbes, *Director, Arizona Experiment Station*

Date palms imported from the Old World into Arizona during the past 23 years have been found generally infested with two scale insects, *Parlatoria blanchardi* and *Phœnicococcus marlatti*, commonly known as the Parlatoria and the Marlatt scales. These two scales are very highly specialized in their food habits, subsisting so far as yet known only upon the date palm.

Parlatoria blanchardi infests the outer parts of the tree, including leaf stalks, foliage and fruit. *Phœnicococcus marlatti*, however, shuns exposed situations and is found deeply buried between the overlapping bases of the leaf stalks, only rarely appearing where the insects may be seen without digging into the tree. Occasionally, also, the Marlatt scale may be found upon partially exposed date palm roots.

In devising a method for the extermination of *Parlatoria blanchardi* several years ago the writer, guided by his observation of the Mexican practice of burning date palms to clear them of dead foliage, drenched the trunks of a number of palms with gasoline and set fire to them. The gasoline blast torch was afterwards found to be much more effective, penetrating inward and downward into the spaces between the leaf bases and thus reaching and exterminating the Parlatoria scale. This method has been in use in the Salt River Valley for the last eight years and this treatment, combined with judicious pruning of the older foliage of infested palms, has been found to accomplish the control of *Parlatoria* thoroughly and economically.

The Marlatt scale, however, by reason of its deep seated location in the date palm is not reached and exterminated by a treatment which suffices for *Parlatoria*. However, by cutting the old leaf stubs of the palm clear down to the bole of the tree, thus largely removing infestations of the Marlatt scale, and by then thoroughly burning the exposed bole of the tree with the gasoline torch, this scale may be entirely removed.

The old Egyptian palms on the Experiment Station Farm near Phoenix, Arizona, thus thoroughly pruned down to the boles and burned in 1906, are found at this time (1913) to be entirely free from Parlatoria and Marlatt scales. On the basis of these observations the following treatment of infested date palms is recommended, and has been adopted by the Arizona Commission of Agriculture and Horticulture: Destroy *Parlatoria blanchardi* on infested date palms and

their attached suckers by pruning and burning with the gasoline blast torch, as described in Bulletin 56 of the Arizona Agricultural Experiment Station. A year after such treatment, if the tree appears to have been successfully treated, as has proved the case with 90 per cent of those burned in Arizona, the suckers may be cut and transplanted, still infested, however, with Marlatt scale.

When the old tree has ceased bearing suckers it becomes practicable to clean the bole and burn it more thoroughly to eradicate Marlatt scale, the tree or orchard of trees being thus finally freed from both infestations. Transplanted suckers, which at the time of cutting could not have borne the severe burning necessary to deprive them of Marlatt scale, can be followed up in the same way and finally freed of infestation.

SOME RECENT MANUALS OF PARASITOLOGY

By Wm. A. Riley

As a rule the economic entomologist is expected to pass upon all questions of parasitology, whether they relate to insects or other forms. The recently awakened interest in medical entomology has made it more imperative than ever that the student planning to go into work in economic entomology should have a good basis in general parasitology. In this connection, the question as to reliable, up-to-date reference-books and compendia is one that frequently arises, and it has seemed that a brief discussion of some of the available texts, with special reference to the latest, would be of help.

Few of the branches of biological science have made more rapid progress during the past few years than has parasitology, and books which were standard until recently, are no longer satisfactory reference books for even those who are not primarily interested in this field. This is especially true of the very phases of the subject which are most intimately connected with the entomological work.

Leuckart's great classic, "Die menschlichen Parasiten," will never lose its value as a discussion of the biological principles underlying parasitism, but it was written years before the pioneer work on the relations between arthropods and parasitic protozoa were suspected and even the discussion of the vermiform parasites is superseded. Moreover, it is long since out of print and the English translation, by Hoyle, is now seldom offered. The work is of such fundamental value that any opportunity to obtain a copy should be seized.

Of the works on this subject of a more economic bearing, none has been more widely cited and quoted in this country than has Railliet's

"Traité de zoölogie médicale et agricole." Many of its eight hundred and ninety-two figures, largely original, have been used so frequently that the source of them is forgotten. Another French text, well known through its English translation by Fleming, is Neumann's "Parasites and Parasitic Diseases of Domesticated Animals." It is of value as a reference book, but is very much out of date, and the English translation contains many careless errors.

Of the books which might be listed as modern, one of the best-known is Braun's "Tierische Parasiten des Menschen," of which the fourth edition appeared in 1908. This edition was thoroughly revised and brought up to date. The English translation, by Pauline Falcke, is of the third edition, with considerable revision by Sambon and Theobald.

A very suggestive little volume is Braun and Lühe's "Handbook of Practical Parasitology," translated by Linda Forster, (Wm. Wood & Co). The discussion of sources of material and of the technique of examining and preserving parasites of all kinds, makes this book one which should be in every laboratory of zoölogy. Its consideration of the Protozoa is especially detailed.

In the line of general text-books of parasitology, the French seem to be able to maintain their supremacy. Of several recent books along this line we shall cite three which seem especially serviceable.

E. Brumpt's "Précis de parasitologie," which appeared in 1910, (Masson & Cie. 12 fr.), is an octavo volume of over 900 pages, with 683 text figures, many original, and four colored plates. Though written primarily for medical students and practitioners, it is one of the best available texts of human parasitology.

Of the same type, though not quite so recent, is Neveu-Lemaire's "Précis de parasitologie humaine," (Rudeval. 8 fr.), of which the fourth edition, greatly revised, appeared in 1908.

Of a much more general nature, and the most recent comprehensive compendium, is Neveu-Lemaire's "Parasitologie des animaux domestiques," (Lamarre & Cie., 1912; 16 fr.). In a volume of 1252 pages, richly illustrated, the author has brought together, coördinated, and presented in a clear and concise manner the latest work in his field. Not only the parasitic animals, but also the plant forms, exclusive of bacteria, are treated, though the part devoted to them covers only 182 pages. In each part, the parasites are studied in their systematic order and, following each, its pathogenic role, treatment, and especially, prophylaxis, are considered. A feature which makes it especially valuable to the non-technical worker is that, at the end of each important discussion are presented in a concise form, the most simple procedure for microscopic diagnosis. At the end of the text there are

about fifty pages devoted to a list of domestic animals and their parasites, arranged according to the organ infested. A brief bibliography and a very complete index add to the convenience of the volume.

During the past year there has also appeared a general text-book of parasitology in German: Fiebiger's "Die tierischen Parasiten der Haus- und Nutztiere," (Braumüller. 1912; 17 Marks). It is fully illustrated, an unusual proportion of the figures being original. Like the preceding, it closes with an extensive list of parasites of domestic animals, but this is far from complete. The author has treated the subject more fully from the zoölogical viewpoint and while the book has much to commend it as a text, it is less satisfactory for reference purposes than is Neveu-Lemaire's.

While this review has to do primarily with general treatises, the reader should not overlook the fact that there is appearing a large amount of important research, in the form of briefer papers, in this country. The studies of Dr. Stiles and Dr. Ransom, and their co-workers in the Public Health Service and in the Bureau of Animal Industry, and the work of Dr. Ward and his students have not only added much original material but have done much to stimulate interest in the subject in this country.

AN IMPORTANT MEANS OF PROMOTING APICULTURE: THE BEEKEEPING DEPARTMENT OF THE CONNECTICUT FAIR

By Burton E. Gates, *Amherst, Mass.*

Apiculture, as a subject of instruction, is making rapid strides among the agricultural colleges. The majority of states are furthering the industry by the enactment and administration of laws to prevent and suppress infectious bee diseases. A further effort to promote bee-keeping comes forth in competitive displays at agricultural and other fairs. Thus far, however, these displays have been relatively meager and often without particular purpose. Not infrequently the products of the apiary are displayed as an adjunct to the floral or horticultural exhibits at fairs. It is unusual for the beekeeping section to occupy a separate building and to offer awards of premiums aggregating $500.00 as at the Hartford (Conn.) Fair.

The competitive display at Hartford is under the direction of the Connecticut Beekeepers' Association, which offers premiums and conducts the displays through its Chairman, Mr. A. W. Yates. Three-fifths of the premium money are available through a state grant and

two-fifths are provided by the Fair management. The management also provides a building 75 x 50 feet, well lighted and equipped with tables. So excellent are the displays that the management regards the beekeeping show as much a feature as the poultry or floral sections.

The premiums offered are large in comparison to similar premiums at other fairs. For instance, for the largest and most attractive display of honey, the first premium is $24.00, the second, $16.00 and third, $8.00. Liberal premiums are also offered for queen rearing outfits, being $16.00, $10.00 and $6.00 respectively. With these seemingly large awards, sufficient interest is aroused among the beekeepers to cause keen competition. One of the exhibitors this year realized $130.00 on premiums.

The benefits to beekeeping derived are, the results of keen competition wherein the beekeeper makes supreme effort to produce the finest sections of honey, to grade them with the utmost discretion, to clean the sections a little better than his competitor, and to pack them in the most attractive form which he can devise. In this way the methods and interest in producing and marketing honey cannot help but be improved. On the other hand, the consumer is enlightened concerning honey. One who is skeptical can satisfy himself that he is procuring the best of pure honey at the fair. He learns to know honey in the open market and acquires a taste for this most wholesome sweet. Furthermore, the public learns that honey differs,—it may be comb, extracted or candied,—and how to use it, for the Fair displays an assortment of culinary products in which honey is used.

The general beekeeper is not without benefit, also, for a most remarkable display of bees is made. In 1913, approximately fifty colonies of different races were on exhibition, and the beekeepers could be seen inspecting the superiority of the premium stock. This collection of bees, without doubt, represented the most choice material available in the country.

Novice beekeepers and the public are afforded opportunities to learn fundamental manipulations of bees, how to handle them so as to avoid stings, to know the features and construction of hives, and to see the brood, the internal features of the colony, through the numerous demonstrations given in the wire cloth-cage by experienced experts. Those who witness such demonstrations, realize how fascinating they are and what crowds are attracted.

From the educational standpoint, furthermore, a relatively unique feature of the Connecticut display is the Section entitled "Competition for Novices," in which it is prescribed that "no one previously exhibiting or receiving premiums shall be considered in this Department." It is at once apparent what this provision affords to the new

beekeepers. While it does not prevent the novice or new beekeeper from competing in other departments, it does afford him an opportunity to display his products and to feel that he has some chance to win a premium in fair competition with similar novices. This wholesome competition, too, encourages the beginner beekeeper to enter the larger competitions in succeeding years. Such a provision in the premium list for any fair is highly commendable.

Beside the strictly competitive displays, space is provided for concessioners who have honey in all its forms, wax, and honey-sandwiches for sale. Those who have charge of the Connecticut Fair, inform the writer that this is an exceedingly important provision, being profitable not only for the concessioners, but also for the management. It is explained that the concessions attract a certain class of people who might not otherwise enter the pavilion. Moreover, it is a means of income to the beekeepers.

Combining these several features of the carefully selected schedule, liberal premiums, an attractive and ample building, classes for the professional and novice, concessions where products are for sale, and the public demonstrations of living bees, presents a most remarkable beekeeping show. Furthermore, the attendance at this Fair probably exceeded several hundred thousand. For the beekeepers, therefore, it cannot help but be a most wholesome stimulus, and a wise method of promoting interests in bees and their products among the people at large.

NEW SPECIES OF MAPLE MITES

By H. E. Hodgkiss, *Geneva, N. Y.*

A systematic study of the Eriophyidæ subsisting on maples has shown the existence of a greater variety of forms than have heretofore been known to occur on these trees. Four species of the mites have been mentioned as inhabiting maples in this country, which are included in the genera Phyllocoptes and Oxypleurites.[1] In our later studies individuals have been discovered which belong in the genera Eriophyes and Anthocoptes, the last-named genus not before being known to occur in North America. The species which have not previously been described may be recognized by the following general characters:

Anthocoptes transitionalis sp. nov. The body is very large with a broad, beak-shaped thoracic shield which projects abruptly downward over the rostrum. The dorsum is highly arched and the striæ are 21 in number, of which the anterior eight

[1] Jour. Econ. Ent. 1:311–313. 1908.

are very long and have a distinct lateral lobe. The ventral striæ are 68 or 70 in number and are coarsely punctuated. The accessory setæ are absent. The legs are long and somewhat slender. The claw is knobbed and much longer than the feathered hair, which is 5-rayed. Length of females, 240 microns; length of males, 230 microns.

Described from individuals taken from a deformed or "pustular" area in smooth bark of the red maple, *Acer rubrum* L.

Eriophyes confusus sp. nov. The body is long and tapering, with a broadly flattened thoracic shield. The striæ are 65 to 70 in number and finely punctuated. The setæ are all present. The legs are long and slender. The claw is knobbed and longer than the feathered hair which is 3-rayed. Length of females, 190 microns; length of males, 150 microns.

Described from individuals found associated with *P. quadripes* Shimer in bladder galls on the leaves of the soft maple, *Acer saccharinum* L.

Eriophyes elongatus sp. nov. The body is long and narrow with a small thoracic shield. The striæ are 70 in number and coarsely punctuated. The setæ are all present. The legs are of medium size. The claw is truncate and longer than the feathered hair which is 4-rayed. Length of females, 216 microns; length of males, 150 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the sugar maple, *Acer saccharum* L.

Eriophyes maculatus sp. nov. The body is long, narrow and the posterior third is gently acuminate. The striæ are 58 in number and coarsely punctuated. The setæ are all present. The legs are short. The claw is truncate and longer than the feathered hair which is 5-rayed. Length of females, 216 microns; length of males, 150 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the sugar maple, *Acer saccharum* L.

Eriophyes major sp. nov. The body is very long, tapering and the thoracic shield is of medium size. The striæ are 70 in number and coarsely punctuated. The setæ are all present. The legs are of medium length. The claw is knobbed and slightly longer than the feathered hair which is 4-rayed. Length of females, 212 microns; length of males, 206 microns.

Described from individuals found among galls of pinkish erineum on the under surfaces of leaves of the red maple, *Acer rubrum* L.

Eriophyes modestus sp. nov. The body is of medium length and width, with a small semi-circular shield. The striæ are 76 in number and are coarsely punctuated along the posterior margins. The coxal setæ I are indistinct; ventral setæ II and the accessory setæ are absent. The legs are of medium size. The claw is knobbed and longer than the feathered hair which is 4-rayed. Length of females, 176 microns.

Described from individuals found among greenish erineum galls on the under surfaces of leaves of the sugar maple, *Acer saccharum* L.,

collected at Bug Lake, Adirondack Mountains, N. Y., by Prof. F. C. Stewart.

Eriophyes negundi sp. nov. The body is very long, tapering, and the thoracic shield is small. The striæ are 70 in number and coarsely punctuated near the caudal margin. The setæ are all present. The legs are of medium length and slender. The claw is knobbed and longer than the feathered hair which is 4-rayed. Length of females, 220 microns; length of males, 200 microns.

Described from individuals found in wart-like swellings of leaves of the black maple, *Acer negundo* L.

Eriophyes ornatus sp. nov. The body is rather long and cylindrical. The thoracic shield is broad and narrow with a distinct geometrical sculpture. The striæ are 62 or 63 in number and coarsely punctuated. The setæ are all present. The legs are of medium length and slender. The claw is knobbed and slightly longer than the feathered hair, which is 4-rayed. Length of females, 187 microns; length of males, 173 microns.

Described from individuals found among pinkish erineum galls on the under surfaces of leaves of the red maple, *Acer rubrum* L.

Eriophyes parallelus sp. nov. The body is of medium size with a small semi-circular shield. The striæ are 54 in number and coarsely punctuated. The setæ are all present. The legs are rather long and slender. The claw is truncate and longer than the feathered hair which is 4-rayed. Length of females, 150 microns; length of males, 145 microns.

Described from individuals found in a whitish erineum on the under surfaces of leaves of the mountain maple, *Acer spicatum* L., collected by Prof. F. C. Stewart at Seventh Lake, Adirondack Mountains, New York.

Eriophyes regulus sp. nov. Body of medium size with a small semi-circular thoracic shield. The striæ are 70 in number and are finely punctuated. The setæ are all present. The legs are of medium size. The claw is truncate and shorter than the feathered hair which is 4-rayed. Length of females, 173 microns; length of males, 120 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the sugar maple, *Acer saccharum* L.

Oxypleurites dentatus sp. nov. The body is of medium length with a broad hemispherical thoracic shield. The dorsum is arched. The dorsal striæ are 23 in number and the lateral margins of the 14 anterior striæ are broadly and sharply serrate; the remainder are narrower with rounded margins. The ventral striæ are 80 in number and finely punctuated along the posterior margin. The accessory setæ are wanting. The legs are short and slender. The claw is knobbed and longer than the feathered hair which is 3-rayed. Length of females, 180 microns; length of males, 120 microns.

Described from individuals found on leaves, especially the under surfaces, of the Norway maple, *Acer platanoides* L.

Oxypleurites dentilobis sp. nov. The body is small, triangular and the lateral margins are bluntly serrate. The thoracic shield is large, ridged, and projects over the rostrum. The dorsal striæ are 23 in number and are ridged along the median. The ventral striæ are 63 in number, slightly swollen along the median and finely punctuated on the posterior margins. The accessory setæ are wanting. The legs are short and stout. The claw is knobbed and longer than the feathered hair which is 3-rayed. Length of females, 176–180 microns; length of males, 170 microns.

Described from individuals found on leaves of the sugar maple, *Acer saccharum* L., in association with *E. elongatus* and *E. maculatus*.

Phyllocoptes brevisetosus sp. nov. The body is very short and narrow, and has a large triangular thoracic shield which projects over the rostrum. The dorsal striæ are 18 in number, very long and ridged at the median. The ventrum is somewhat swollen anteriorly and the striæ, which number 75, are finely punctuated on the posterior margin. The coxal and ventral setæ are very short and the accessory setæ are wanting. Length of females, 180 microns; length of males, 120 microns.

Described from individuals found on leaves of the black maple, *Acer negundo* L.

Phyllocoptes constrictus sp. nov. The body is large, much distended anteriorly and abruptly acuminate caudad. The thoracic shield is very large, arched and projects over the rostrum. The dorsal striæ are 65 in number and smooth. The ventral striæ are about 110 in number and fine punctuations occur in the middle of the striæ. The accessory setæ are absent. The legs are long and stout. The claw is knobbed and longer than the feathered hair which is 6-rayed. Length of females, 183 microns; length of males, 146 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the sugar maple, *Acer saccharum* L.

Phyllocoptes magnificus sp. nov. The body is very large, much swollen and has a very large hemispherical thoracic shield. The dorsal striæ are 42 in number. The striæ on the ventrum are 75 in number and rather coarsely punctuated. The setæ are all present and are long. The legs are very long and stout. The claw is knobbed and longer than the feathered hair which is 6-rayed. Length of females, 207 microns; length of males, 180 microns.

Described from individuals found in epidermal hairy growths which occur in the axils of the veins on the under surfaces of leaves of the Norway maple, *Acer platanoides* L.

Phyllocoptes minutissimus sp. nov. The body is very small and tapers caudad. The thoracic shield is large and broadly flattened at the anterior margin. The dorsal striæ are 28 or 29 in number. The ventral striæ are 53 or 54 in number and coarsely punctuated. The setæ are all present. The legs are short. The claw is knobbed and longer than the feathered hair which is 3-rayed. Length of females, 110 microns; length of males, 103 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the red maple, *Acer rubrum* L.

Phyllocoptes quinquilobus sp. nov. The body is of medium size. The posterior margin of the thoracic shield is five lobed. The dorsal striæ are 35 in number and smooth. The ventral striæ are 68 in number and are finely punctuated. The setæ are all present. The legs are of medium length and slender. The claw is knobbed and somewhat longer than the feathered hair which is 4-rayed. Length of females, 170 microns; length of males, 150 microns.

Described from individuals found among pinkish erineum galls on the under surfaces of leaves of the red maple, *Acer rubrum* L.

Phyllocoptes splendidus sp. nov. The body is very large and the margins are strongly curved. The thoracic shield is very large, with the lateral margins converging abruptly forward. The dorsal striæ are about 60 in number and coarsely punctuated. The ventrum is swollen and the striæ, which are 85 or 86 in number, are finely punctuated. The accessory setæ are wanting. The legs are long and slender. The claw is truncate and the feathered hair is 5-rayed. Length of females, 220 microns; length of males, 216 microns.

Described from individuals found associated with *E. negundi* on leaves of the black maple, *Acer negundo* L.

Phyllocoptes trilobis sp. nov. The body is long and tapering with a large triangular thoracic shield, the posterior margin of which has three broad lobes. The dorsal striæ are 23 in number. The ventrum has 68 finely punctuated striæ. The accessory setæ are wanting. The legs are long and stout. The claw is knobbed and much longer than the feathered hair which is 4-rayed. Length of females, 200 microns; length of males, 180 microns.

Described from individuals found on leaves of the Norway maple, *Acer platanoides* L.

Phyllocoptes variabilis sp. nov. The body is of medium size, broadest behind the shield and gently acuminate to anal lobes. The thoracic shield is large, triangular and projects bluntly above the rostrum. The dorsal striæ are about 32 in number and smooth. The ventral striæ are 62 in number and finely punctuated along the posterior margin. The setæ are all present. The legs are of medium size. The claw is knobbed and somewhat longer than the feathered hair which is 4-rayed. Length of females, 180 microns; length of males, 150 microns.

Described from individuals found among red erineum galls on the upper surfaces of leaves of the sugar maple, *Acer saccharum* L.

An Eriococcus on Eriogonum. On July 14, Mr. E. Bethel found a species of *Eriogonum* at Lake Eldora, Colorado, swarming with a small mealy-bug, and sent a quantity to me alive. On examination the species proves to be *Eriococcus borealis* Ckll., having the characteristic antennæ (7-jointed in this material), denticle on claw, etc. In some cases the tarsus is as long as the tibia. The living insects, prior to the formation of the sac, are very pale creamy white, with the sides of the body conspicuously hairy.

T. D. A. Cockerell.

Scientific Notes

A Leaf-Cutting Bee from Arizona. In Journal of Economic Entomology, April 1913, p. 195, Mr. A. W. Morrill called attention to the injury done by bees of the genus *Megachile* in Arizona. More recently he has sent specimens which he received from Salome, Arizona, to Mr. J. C. Crawford, who has forwarded them to me for identification. They were collected at Salome, May 20, 1913, and were said to be quite destructive. The species proves to be *M. lippiæ*, differing a little from the New Mexico type in the pale hair of the ventral scope being clear white, instead of somewhat yellowish. As *M. lippiæ* was originally described as a variety of *M. cleomis*, with only comparative notes, it may be well to publish a description which will enable it to be recognized by those who have no *M. clcomis*. In general, the females look like those of *M. addenda* and *generosa* (of which *cleomis* is a subspecies), but when the abdomen is seen from above, only the last two segments show black at sides in *lippiæ*, while in the others mentioned segments 2 to 6 show black.

Megachile lippiæ (Cockerell). Female, length about 14 mm.; moderately robust, the abdomen not parallel-sided; black with the pubescence nearly all white, but some black on vertex, mesothorax and scutellum, on subapical margin and extreme sides of fifth abdominal segment, at sides of sixth segment, and on last ventral segment except basally; head very broad, the large reddish-brown eyes diverging above, the lunar orbits above conspicuously concave; face with much white hair, very dense and spreading at sides; mandibles broad, quadridentate, but the innermost tooth little developed; lower margin of clypeus quite simple; clypeus shining but well punctured; flagellum marked with dark red beneath; mesothorax not very hairy, and wholly without white lines of hair in front, its greater part closely and finely punctured, but the posterior middle with more separated punctures and in the Arizona form somewhat shining; tegulæ rufopiceous, the margins lighter; wings hyaline, broadly dusky on apical margin; legs with white hair, that on inner side of basitarsi pale orange, and on small joints of tarsi coppery-tinted; hind basitarsi moderately broadened; abdomen shining, finely punctured, with narrow white hair-bands; last dorsal segment nearly straight in lateral profile, pruinose, with fine short greyish-white hair, but at sides with long erect black hair.

T. D. A. Cockerell.

A Parasite of the Chinch Bug Egg. In the experiments conducted this year to determine the time of the first appearance of young chinch bugs and the mortality of the eggs, a large number of eggs were collected in the field for examination. The eggs which were collected at different intervals and in different localities were examined daily. While thus examining the eggs it was noticed that some of them became dark in color instead of assuming the usual red coloring. These eggs were isolated and on May 19, there emerged from them three parasites. With these three parasites as a basis, the life history was carried through four generations, running up to July 5. Since this was the time between the two broods of the chinch bug, it became impossible to obtain additional chinch bug eggs with which to continue the work. From July 5 to July 23 only an occasional parasitized egg was found in the field, but beginning with the latter date, parasitized eggs were found in large numbers in the corn fields and the second generation was obtained by August 10. Up to the present date this year over 275 individual parasites have been bred out. The length of the life cycle has been found to vary from ten to eighteen days, depending on climatic conditions.

The parasite has been found in every wheat and corn field examined around Manhattan. Of 3,101 eggs collected between April 28 and June 10, the average percent of parasitism was 20.8, and of 116 eggs collected at Crawford (central Kansas) 19 eggs or 16.3 were parasitized.

The work is still under way and a full description of the parasite together with notes on its life history and efficiency will be published later. Mr. Crawford of the U. S. National Museum concludes that this parasite represents a new genus and species of the Proctotrypidæ.

James W. McColloch.

Swarming of Hemiptera. On the evening of July 1 of the present year, Boulder, Colorado, was visited by incalculable numbers of *Lygæus facetus* Say. Coming home at about 10.30 p. m., I found them in clouds about the electric lights, presenting the same appearance as the Trichoptera at certain seasons in the vicinity of the great lakes. They exhaled a strong and disagreeable cimicoid odor. In some parts of the town, I was informed, they were swept up with brooms. The weather here has been exceedingly hot and dry for many weeks, and one can only suppose that the bugs were compelled to migrate owing to the drying up of their usual food supply. Once before, in Boulder, I have observed a similar phenomenon, the species in this case being Homopterous. On September 21, 1908, I found on the steps and in the basement of the University of Colorado library enormous numbers of Homoptera, mostly dead. I nearly filled a small mason jar with them, and could have secured many more. The great majority, probably at least 90 per cent, were *Xerophlœa viridis* (Fabr.). The only other species at all abundant was *Limotettix exitiosus* Uhler. *Agallia uhleri* V. Duzee was the next in numbers. There were also some miscellaneous insects, including two *Nysius angustatus* Uhl., and one *Lygæus facetus* Say. The *Xerophlœa viridis* were nearly all of the green form, but pink and light brown individuals occurred in small numbers. The brownish variety is doubtless var. *grisea* (Germar). The species *X. viridis* ranges from Massachusetts to Brazil. The swarming of a Lepidopterous insect, *Homœosoma electellum*, at Boulder, has already been recorded in Entomological News.

T. D. A. Cockerell.

Observations Regarding Flight of the Cotton Moth in 1911. In 1911, certain work on the canal of the Bulls Bridge power plant at Merwinsville, Conn., necessitated day and night work and to facilitate the latter we had a number of electric arc lights at the two points where work was progressing, there being six arcs at one point in a stretch of 300 feet and 10 or 12 lights at the other point in a section about the same length, perhaps 200 feet wide, both localities being in the valley of and close to the Housatonic River. On September 23, in reporting conditions at the work my representative stated there were "millions of moths" around the lamps and on Monday, the 25th, when I personally visited the work I found every one of the wooden frames, from which the arc lights were suspended (these frames consisting of an upright 4″ x 6″ and perhaps 10 feet high and a cross arm at the top about 5 feet long, from which the lamps were hung), covered with moths for the most part as closely together as they could get. These were almost entirely cotton moths. There were, however, 30 to 40 specimens of *Tolype velleda*, four or five Sphinx moths, several *Catocalas* and a few other species. The ground surrounding these lights was also completely covered with the moths and when disturbed they made a noise like the rustling of dry leaves. The superintendent reported that for two or three nights previously there had been far more than I found Monday morning; that at times

they crowded so thickly about the arc lights as to almost completely obscure them. I was not on the ground again for some little time, but was advised by the men that Monday night there was a very marked reduction in the number and that Wednesday night there was practically none at all. I had nothing except a bottle of chloroform with which to collect specimens, but by simply pouring this down one of the posts it was possible to secure plenty of specimens which were in excellent condition.

CHARLES RUFUS HARTE,
Construction Engineer.

A Rhododendron Borer (*Corthylus punctatissimus* Zimm.) This ambrosia beetle was found the latter part of September working in rhododendron stems. The borers entered the plants near or just a little below the surface of the ground and so thoroughly riddled the affected parts that the shoots wilted and were easily broken off. There were a series of closely set, circular, nearly horizontal galleries with numerous vertical brood chambers. These series were double or treble and were united by more or less vertical connecting galleries. The work of this borer was not found more than six inches above the ground and the galleries rarely extended more than two or three inches below the surface. We found no cases of root invasion though in some instances the insects worked close to the crown of the plant. This beetle seems a rather serious, though distinctly local pest in the vicinity of New York City. It can be controlled by cutting out and burning the affected stems. Care should be exercised not to break infested shoots since there is then danger of some of the beetles escaping destruction. The insect seems to display a marked preference for well shaded plants.

E. P. FELT.

THE 26TH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The 26th annual meeting of the American Association of Economic Entomologists will be held in Atlanta, Ga., during the week beginning December 29, 1913, under the Presidency of Professor P. J. Parrott, of Geneva, N. Y. Arrangements will be made for holding sectional meetings of Horticultural inspection and Apiary inspection. During the week a program will be arranged so that closely related subjects will be grouped as much as possible.

During the same week the annual meeting of the Entomological Society of America will be held, and it is anticipated that many papers of great interest to working entomologists will be presented for consideration and discussion. The program of the meeting of this Association will be issued in the December number of the Journal, and this preliminary announcement is being made, so that all members may be advised and can make plans to be present at this important meeting.

A. F. BURGESS, *Secretary.*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The Ohio State University, in a recent issued circular, offers a comprehensive course in applied or economic entomology, extending through a period of four years, beginning with fundamental studies in zoology and making provision in later years for a study of various phases of applied entomology. This is a significant commentary upon the importance of practical work in this branch of science. The authorities of the University and the head of the department directly responsible for the venture, are to be congratulated upon taking this progressive step.

The international character of American work in economic entomology is becoming increasingly apparent with the progress of time. We were favored in 1911 by a visit from a noted German entomologist (a summary of his impressions is reviewed elsewhere in this issue), while this season a well-known French savant has been studying our methods. Students have begun to avail themselves of our special facilities for studying large-scale operations in practical entomology. This is a most sincere form of approbation and, while gratifying, should also prove stimulating. It is not sufficient to have attained the desired end. The leadership must be maintained and the latter may mean more strenuous efforts than the former.

Our friends from abroad have naturally had a better opportunity of seeing the strong, rather than the weak points in our system. Every American entomologist is cognizant of hampering conditions in some direction, occasionally in many. The demand for "immediate" or "practical" results is frequently insistent. There is often need of a better correlation between research and extension work, since one is apt to overbalance the other; the former may lose much of its effectiveness if there is too little of the latter, and vice versa. Inspection and quarantine service, desirable though they may be, absorb time and strength in some instances at least, from relatively more important work. Then, if in addition, a considerable amount of time must be given to instruction, it is obvious that some line of productive effort

must be slighted. There is more or less undesirable duplication of work and overlapping of spheres of activity. These obstacles to the best progress are being gradually overcome, and for the most part it is gratifying to state that they are of minor importance, though noteworthy factors as competition becomes more keen.

Reviews

Entomology, with Special Reference to its Biological and Economic Aspects, by J. W. Folsom. Second revised edition, pages 402, plates 4, text figures 304. Blakiston Sons & Co. 1913.

The new edition of this standard work has been reset and thoroughly revised. Much new matter has been incorporated here and there, the most important being a chapter on the transmission of diseases by insects. There are several new figures, others have been improved, and over 100 titles added to the well selected and extensive bibliography. The slightly larger pages and thinner paper have effected a desirable reduction in thickness and weight. The colored plate of the first edition is omitted in the revision, and the same is true of a chapter on origin of adaptations and species.

We have in this volume an admirable summary of the fundamentals of insect biology and ecology, with special reference to the economic applications. It is an invaluable supplement to our somewhat numerous taxonomic works. Familiarity with its contents is one of the best possible preparations for the economic entomologist, the man who is primarily concerned in ascertaining biological relationships. This edition, price $2.25, should be in the library of every working entomologist.

The Reduction of Domestic Flies, by Edward Halford Ross. 103 pages, 18 illustrations; J. B. Lippincott Company, Philadelphia, and John Murray, London. 1913. Net, $1.50.

This volume is a companion to the author's "The Reduction of Domestic Mosquitoes" which appeared a year or more ago. It is written by an Englishman and from an English standpoint. The book contains twelve chapters with titles as follows: "The Importance of Domestic Flies; The Fly-Egg, the Larva, and the Chrysalis; The Life and Habits of Domestic Flies; The Fly's Enemies; How to Reduce Flies; The Beginning of the Anti-Fly Campaign; Early Fly Reduction; The Organized Anti-Fly Campaign; Opposition; The Justification of Expenditure of Money and Energy; The Life and Death of *Worry* the Fly; Sanitary Education, Flies, and the Coming Generation."

This book is not without faults, yet it has a mission, for many will see it in libraries and from it learn how to start a campaign against flies. The sooner that the people are interested and educated in insect sanitation, the better for human life and health. We should therefore welcome any intelligent discussion of the subject, though there is no better authority, or one whose advice is safer to follow, than our own Doctor L. O. Howard.

W. E. B.

A Laboratory Guide to the Study of Parasitology, by W. B. Herms. The Macmillan Company, p. 1–72, 1913.

The teacher of biology will find much suggestive in this guide to the study of parasitology, using this term in a somewhat broad sense and with special reference to its economic bearings. The author has not hesitated to include one or two forms which may not prove to be pathogenic, since it is comparatively easy to omit a lesson or two. Outlines are given for the study of various types of insects mouth-parts and their bearing on the dissemination of disease elucidated. Representative types, such as the bird and true lice, bed bugs, cone-noses, mosquitoes, horse flies, house flies, stable flies, etc., are assigned to one or two periods of two and one-half to three hours. Parasiticides, amoebæ, trypanosomes and malarial parasites are also provided for in the course, a total of about 40 lessons.

Part 2 is devoted to helminthology, the various types of worms being studied in much the same way, one lesson dealing with anthelminthics.

The provision for biological work in part 3 adds greatly to the value of the guide in our estimation since the students thus have an opportunity of seeing a portion of the processes in operation. The author has naturally selected for this easily obtained and handled forms such as the house fly, the mosquito and flea.

There is enough in each lesson to guide the student working under competent direction though comparatively little can be learned from the guide itself. The student is compelled to study the material or rely in large measure upon the instructor, our ideal in laboratory guides.

Biologien heimischer Schmetterlinge schädlich in Garten, Feld und Wald. By Paul Ihle. Böhler u. Recke, Biebergasse 8, Frankfurt a. Main, Germany. Three Series. Marks 22.50.

This recent publication consists of a collection of thirty colored plates of the different stages in the life history of some of the more common insect pests of the gardens, fields and forests of Europe, each plate accompanied by explanatory inscriptions. The coloring is excellent (the writer has compared the plates with specimens of the insects), and the drawing good.

Perhaps the work will be of most value in North America to those engaged in the inspection of imported nursery stock, as many of the insects figured are liable to reach this country on importations, and a study of the figures of the different stages should be of great assistance to inspectors, teaching them what to watch for. The low cost of the work (about $5.75) should bring it within the reach of all, and the importance of an acquaintance with the appearance in their different stages, of pests likely to reach this country at any time would seem self-evident. The writer is informed that it is not unlikely that additional series and descriptive text may be issued later if the demand should seem to justify it. G. E. Stechert & Co. of New York are handling the work.

H. T. F.

Die Angewandte Entomologie in den Vereinigten Staaten (Applied Entomology in the United States) by K. Escherich, pages 196, figures 61, Paul Parey, Berlin. 1913.

This work contains much familiar to Americans and is of interest because it records the impressions of a gifted European qualified by experience to pass expert judgment.

The journey was made possible through the generosity of Mr. Carnegie. The author's itinerary included Washington and most of the Federal Field Stations as well as a number of the more important (from an entomological standpoint) Agricultural Experiment Stations, Entomological Departments of Universities and offices of State Entomologists. The first part discusses organization and agencies, and the second gives a summary of control methods as practised in this country. The critical remarks upon the biological method of controlling insects are especially valuable and a translation of these by Dr. E. A. Schwarz, transmitted through the courtesy of Dr. Howard, follows:

"We have now learned [in the preceding chapters] of a variety of biologic warfares. The success of them was very diversified; excellent in some cases; in others less satisfactory, and, again, in others entirely negative. From this fact it is to be concluded: (1) It is not an Utopia [a dream] *but an established fact that insect calamities can be successfully fought and terminated by artificial multiplication or importation of parasites;* (2) *but on the other hand we learn therefrom that the biologic method does not constitute an universal remedy.*

"It is self evident that a warfare by means of parasites can only be successful where the devastation is due to a scarcity or absence of parasites. There is a whole series of insect eruptions which are caused by other factors: for instance, the multiplication of Scolytid beetles depends much less upon the diminution of the number of parasites and enemies than on the increase of food material. In this case it would be of no use to introduce *Clerus formicarius* and the various Ichneumonids if at the same time care had not been taken to remove the dying trees. Or, take the case of the Phylloxera which in the vineyards of Europe does such tremendous damage. It would be a useless attempt to counteract this pest with natural enemies. For it is not the absence of such enemies which renders the Phylloxera such a dreadful pest in Europe, but the real cause is the smaller power of resistance of the grape vines. Many similar instances could be given.

"But apart from such cases where the biologic method necessarily appears to be excluded, there are still other cases where in spite of apparent possibility the biologic warfare is not employed and the mechanical warfare is preferred, namely in cases where we have to deal with a very short outbreak and where we have immediately to use remedies; or in cases where we have on hand cheap, easily applicable and sure, mechanically acting remedies. For we must not lose sight of the fact that parasites and enemies are also subject to all sorts of influences by which their efficacy is again lowered or delayed so that the degree of the efficiency [of the biologic method] can not be foretold with the same degree of certainty as with many technical methods.

"Finally there are cases where the biologic method is to be used only to assist the mechanical method. For instance, where the caterpillars are, by the lime rings, prevented from ascending the trees, the efficacy of this mechanical remedy can be essentially increased by the protection and introduction of parasites, etc.

"That the Americans are fully and correctly aware today of all these points, is made sufficiently clear from the foregoing report [i. e. in the body of the book]. To be sure, there was a time when too optimistic views were indulged in by some, and when the biologic warfare was considered as an almost universal remedy,—namely at the time when the importation of *Novius cardinalis* resulted in such a wonderful success. But those times are gone. At least the leading entomologists of America, with Howard in their lead, never think of fighting all pests with parasites; they are too well aware that this method is only adapted to certain specific cases. And further, they have also learned in the meantime that the introduction and acclimatization of parasites is not always such an easy matter as in the case of *Novius*

cardinalis, and that, on the contrary, this method is, in most cases, connected with great difficulties. What enormous amount of the most serious scientific work on the part of the investigators to place the introduction of the parasites of the Gypsy moth on a sure basis! *It is only when the life-histories of the parasites in all their peculiarities are fully studied and when their mode of attacking and the degree of attack on the host have been exactly ascertained—only then the practical utilization of parasites can be thought of. This is the 'Axiom' of the biologic warfare* which today is strictly adhered to by Howard and his school.

"If there were many errors committed at first, and if many costly experiments were failures—this is only natural. Through Error to Victory! Most of our modern roads do not lead to their destination in a straight line, and frequently it is through failures that we advance the farthest! [P. 131.] We should rejoice that the Americans have gone through the most difficult part of this road, *and we should now not longer hesitate to join them and, for the benefit of forestry and agriculture, to follow them, shoulder to shoulder, on the road which they have conquered after such a hard struggle.* For it can not be doubted that the biologic method has still a promising future and that it will occupy a constantly broadening part in the warfare against insect pests."

The author gives an excellent historical summary of the development of applied entomology in this country, taking the work of the Federal Bureau of Entomology as a criterion and discussing activities of other entomologists wherever necessary to round out the account, and finds much to commend. The illustrations are mostly from the publications of the Bureau of Entomology. The author was so deeply impressed with the soundness of our methods that he advocates for Germany a similar system with some modifications and has taken preliminary steps for the formation of an Association of Economic Entomologists similar to that in this country.

Current Notes

Conducted by the Associate Editor

Mr. A. B. Shaw has resigned as assistant in entomology at the California University and Station.

The appropriations to the Ohio Station for 1913, made by the legislature, include $8,000 for entomology.

Mrs. Anna Botsford Comstock has recently been appointed assistant professor of entomology and nature study in Cornell University.

Mr. H. L. Viereck was with the Minnesota State Entomologist during August and September.

At the California University and Station, G. A. Coleman, E. C. Van Dyke and L. J. Nickels have been appointed instructors, and R. E. Campbell as assistant in entomology.

Mr. Charles W. Howard was promoted from instructor to assistant professor of entomology, University of Minnesota, by the Board of Regents, at the June meeting.

Mr. Harry Pinkus, an agent of the Bureau of Entomology and an associate member of this Association, died, August 27, at Dallas, Texas.

At the Ohio State University a new biological building is being erected. It will house the departments of zoölogy and botany and will be provided with greenhouses and an insectary.

Professor J. S. Kingsley, for twenty-one years professor of zoölogy in Tufts College,

has recently been appointed professor of zoölogy at the University of Illinois. He will there have charge of the vertebrates.

Mr. Dayton Stoner, instructor in zoölogy at the State University of Iowa, spent the summer in the insectary of the Iowa Experiment Station at Ames.

Sir Patrick Manson, at the recent International Medical Congress, was presented with a gold plaque symbolical of triumph over tropical diseases.

Dr. W. L. Tower, of the University of Chicago, has been made curator of the new bionomic laboratory, and has gone to South America to collect material for it.

Professor Ernest Walker, formerly of the University of Kansas, has recently been appointed head of the horticultural department of the Alabama College and Station.

Professor T. D. A. Cockerell, professor of zoölogy at the University of Colorado at Boulder, was given the honorary degree of Sc.D. by Colorado College at its last commencement in June.

Colonel William C. Gorgas has been invited to visit Johannesburg, South Africa, to advise regarding sanitary conditions there. He has asked for a leave of absence that he may accept the invitation.

Professor C. E. Bartholomew of the Agricultural College at Ames, Iowa, had charge of the instruction in entomology at the Macbride Lakeside Laboratory on West Lake, Okoboji, Iowa, during the summer.

Mr. M. P. Somes, assistant entomologist of the South Carolina Agricultural Experiment Station, has been appointed entomologist of the Missouri Fruit Experiment Station at Mountain Grove, Mo., where he should now be addressed.

Professor H. A. Morgan, Director of the Tennessee Station, visited Europe in the summer as a member of the Southern Commercial Congress, to study the rural credit systems there.

Mr. G. P. Weldon has resigned as assistant entomologist of the Colorado Station and instructor in the college, to accept a position as Chief Deputy Commissioner of Horticulture in California, succeeding Mr. Geo. E. Merrill.

Mr. Irving W. Davis, B.S., a graduate in 1911, of the Massachusetts Agricultural College at Amherst, Mass., has been appointed assistant in entomology at the Connecticut Station at New Haven, and has taken up his work there.

Mr. A. C. Mason, B. S., a graduate of the Michigan Agricultural College, class of 1913, has been appointed laboratory assistant in entomology under Professor J. R. Watson, at the Agricultural Experiment Station, Gainesville, Fla., and began his work July 1.

Dr. A. D. Ihms has been appointed Reader in Agricultural Entomology in the Victoria University of Manchester, England. He was formerly professor of biology in the University of Allahabad and afterwards Forest Entomologist to the Government of India at the Imperial Research Institute, Dehra Dun, India.

Mr. W. O. Ellis, instructor in zoölogy at the Iowa State College, has gone to Washington State College as instructor in zoölogy and assistant in entomology in the experiment station. Mr. Ellis served as an insectary assistant at the Iowa station during the past summer.

According to *Science* Dr. J. E. Wodsedalek, formerly of the zoölogical department of the University of Wisconsin, has been appointed professor of zoölogy and head of the department of zoölogy and entomology at the University of Idaho, Moscow, Idaho, as a successor to J. M. Aldrich.

Professor C. T. Brues, Bussey Institution, Forest Hills, Mass., was a member of a special expedition to Peru led by Dr. Richard P. Strong, from the Harvard Medical School, to study infectious diseases of South and Central America. The party sailed from New York April 30th and will return in the fall.

Paul S. Welch Ph. D. has been appointed instructor in the college and assistant

in the Station in the department of entomology, Kansas Agricultural College, in place of Dr. M. C. Tanquary, who resigned to accompany the Crocker Land Expedition.

Dr. John W. Scott, assistant professor of zoölogy, Kansas Agricultural College, has resigned to become professor and head of the department of zoölogy and parasitology at the University of Wyoming. His place at Kansas has been filled by the appointment of Dr. J. E. Ackert, of the University of Illinois.

H. F. Wilson has been appointed head of the entomological department at the Oregon College and Station, and hereafter Professor A. B. Cordley will give his entire time to his work as dean of the school of agriculture. A sub-station has been extablished at Hood River for the purpose of studying the fruit insects and diseases.

Mr. James F. Zimmer formerly in charge of the Insecticide Testing Laboratory of the U. S. Bureau of Entomology at Vienna, Va., has resigned to accept a position as Assistant State Leader in Farm Management, at Manistee, Mich. His duties will be to Assist the fruit growers and farmers along the eastern shore of Lake Michigan.

Professor A. G. Ruggles, who was granted leave of absence that he might serve as entomologist for the Pennsylvania chestnut tree blight commission, has returned to his work at the University of Minnesota. The Pennsylvania work was stopped because the appropriation was considered inadequate and was vetoed by the Governor.

Mr. W. F. Fiske, formerly of the Bureau of Entomology and with headquarters at the Gypsy moth parasite laboratory, Melrose Highlands, Mass., is now employed in connection with investigations into the Trypanosome diseases of man and domestic animals in Africa. His address is, Care of Tropical Diseases Committee, Royal Society, Burlington House, London, England.

Professor A. J. Cook, horticultural commissioner of California recently had to face charges of incompetency made by a self appointed body called the Horticultural Welfare Committee. This committee claimed that Professor Cook's administration has been injurious to the fruit industry of the state. No case was presented, however, against Professor Cook, who was wholly and emphatically vindicated by Governor Hiram Johnson.

Mr. E. P. Van Duzee, formerly of Grosvenor Library, Buffalo, N. Y., is now at Scripps Institution, La Jolla, California, where he divides his time between library work and in studying the hemiptera. Mr. Van Duzee will probably remain on the Pacific coast, and will continue his work in entomology, being now engaged in preparing a catalogue of North American Hemiptera. Correspondents should send letters and specimens to the address given above.

According to *Science* "Mr. C. W. Mason of Wye, England, and Mr. Donald McGregor of Oxford, have been appointed Carnegie scholars in entomology under the Imperial Bureau of Entomology. Mr. Mason arrived in the United States early in July and is now studying at the laboratory of parasitology of the Bureau of Entomology of the United States Department of Agriculture at Melrose Highlands, Mass. He will study in this country for one year. Mr. McGregor will arrive in New York soon and will probably join Mr. Mason at Melrose Highlands."

The American and the Pacific Coast Associations of Nurserymen, which met in joint convention at Portland, Ore., passed resolutions and appointed a committee to aid in bringing about more uniform legislation regarding inspection and certification of nursery stock in the different states. The following standing committee was appointed to take charge of the work: William Pitkin, Rochester, N. Y., Chairman; Peter Youngers, Geneva, Neb., Treasurer; M. McDonald, Orenco, Ore.

Professor W. T. Shaw, zoölogist of the Experiment Station, professor of Zoölogy

and Curator of the museum in the college, Pullman, Wash., will be acting head of the department of Entomology and Zoölogy for the coming year, during the absence of Professor A. L. Melander, who has been granted a year's leave of absence for research work at Harvard. Mr. M. A. Yothers, Assistant Entomologist of the Station, will have charge of entomological investigations. Mr. E. O. Ellis, who this spring received his Master's degree from the Iowa Agricultural College, has been elected to the position of Instructor in Entomology, and Assistant in Entomology in the Station.

The apicultural department of the Agricultural College at Amherst, Mass., has been strengthened by increasing the apiary and by appointing a superintendent in the person of Mr. John L. Byard, of Southboro, Mass., formerly a deputy apiary inspector in the state. Mr. Byard is now president of the Massachusetts State Beekeepers' Association and for three years was president of the Worcester County Beekeepers' Association. He has a wide acquaintance with the beekeepers of his state and a good knowledge of his subject, having been generally recognized as a successful apiculturist. Mr. Byard will assist in laboratory and demonstrational work with students and at institutes and conventions, but his services will be chiefly confined to the maintenance of the college apiary and its equipment.

Science is responsible for the statement that "Mrs. A. H. Clarke, of Earl's Court, has given to the University of London the collection of continental and exotic macrolepidoptera made by her late husband, who was one of the senior fellows of the Entomological Society. The section of exotic butterflies consists of nearly 6,000 specimens from all parts of the world, and is particularly valuable as a reference collection, not merely from the number and careful selection of the forms represented (some being of great rarity), but from the perfect condition and beauty of the specimens themselves. The whole donation comprises over 12,000 specimens all carefully set, arranged and labeled; and to it Mrs. Clarke has added her husband's working library of entomological literature. After the work of arranging and cataloguing has been concluded, the collections will be available for reference by entomologists generally upon application to the professor of zoölogy at the university."

According to Canadian Entomologist, Mr. John D. Tothill, B. S. A., a graduate of the Ontario Agricultural College, Guelph, has been awarded the Carnegie Scholarship in Entomology in order to enable him to take a year's post graduate course at Cornell University. The value of the scholarship is $625.00 and includes traveling expenses. These scholarships are somewhat similar in character to the Rhodes scholarships at Oxford and are intended to enable qualified young men in various parts of the British Empire to spend a year in study at some University in the United States. Mr. Tothill is a field agent of the Division of Entomology at Ottawa, and is at present carrying on investigations under the direction of Dr. Hewitt, on the work of parasites of the Brown-Tail Moth in N. B., his headquarters being at Fredericton.

The Division of Entomology of the Minnesota Experiment Station has adopted the Sectional plan. All sections are of equal rank. One section, comprising spraying and shade tree and forest insects, is under the direction of Mr. A. G. Ruggles. Mr. William Moore of Cornell, just returned from South Africa, has charge of the section on Greenhouse and truck crop insects. Mr. C. W. Howard, from South Africa, also a Cornell graduate, has charge of the section on Forage crop insects and also insects and diseases. Mr. A. J. Spangler is chief nursery inspector under the direction of the State Entomologist who has, by law, that work in charge.

Mr. Charles H. T. Townsend, Government Entomologist and Director of Entomological Stations, was some time ago especially charged by the Peruvian Government with the investigation of the insect transmission of verruga. On the 30th of June, he announced, from the entomological evidence alone, the practical certainty that

Phlebotomus was the verruga vector. On July 11 he injected a dog with triturated bodies of females of the *Phlebotomus*, and secured the verruga eruption on July 17 as a result. This is the first case of experimental transmission of the disease through the medium of insects. Details of the case are being published. This investigation has furnished another striking illustration of the value of expert entomological work. For thirty years the medical fraternity of Peru has labored to solve the mystery of the origin and transmission of verruga. Yet six months' work by a practical entomologist has definitely indicated the carrier. The result is that the disease loses its mystery and can be confidently guarded against. It was possible to draw up a practical demonstration of *Phlebotomus* as the transmitting agent from the entomological investigation alone, without waiting for the transmissional proof. The Peruvian authorities are fully alive to the importance of the discovery.

Mr. D. L. Crawford, Entomologist and Horticulturist of the Mexico Gulf Coast Citrus Fruit Association, located at Apto. 293, Tampico, Mexico, has just issued a circular on the Control of the Orange Maggot. This is the first of a series which may appear at regular intervals and also embody the results of his investigations of other insects. Mr. Crawford will gladly supply this circular upon application by interested parties.

The Ohio State University has established a course in Applied Entomology and announces a course of study, leading to a Bachelor of Science degree, to cover four years of under-graduate work, including such subjects as Modern Language, Chemistry, Botany, Zoölogy, Geology, Horticulture and Agronomy, besides a number in strictly technical Entomological works. It is intended to fit students for technical work in the Bureau of Entomology, Experiment Stations, State and Federal Quarantine Service or as Investigators in Boards of Health or other professional positions.

The following notes are copied from The Review of Applied Entomology for August, page 304:

Mr. R. H. Deakin has been appointed as Assistant Entomologist at Nairobi, East Africa Proctectorate. Mr. F. P. Jepson, Government Entomologist of Fiji, left Java in July, having been there to search for parasites of the Banana Weevil (*Cosmopolites sordidus*, Germ.). Dr. W. A. Lamborn has been appointed as Entomologist of the Department of Agriculture, Southern Nigeria, in the place of Mr. A. Peabody (invalided). Mr. Gilbert Storey has been appointed as Assistant Entomologist to the Egyptian Department of Agriculture. The appointment of Mr. F. W. Urich as Entomologist to the Board of Agriculture has been renewed for a further period of two years. The vacant Carnegie Scholarships of the Imperial Bureau of Entomology have been allotted to the following gentlemen: Mr. R. E. McGregor, Trinity College, Cambridge, for two years; Mr. A. R. Ritchie, Glasgow University, for two years; Mr. C. Mason, South-Eastern Agricultural College, Wye, for one year; and Mr. J. W. Tothill, Assistant Entomologist, Dominion of Canada, for six months. The Sleeping Sickness Commission of the Royal Society have arranged to send Mr. W. F. Fiske (lately of the U. S. A. Bureau of Entomology) to East Africa in September, for the purpose of studying the bionomics of *Glossina.*

Mailed October 29, 1913.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER, P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS.
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD, Wooster, Ohio.

BACK NUMBERS WANTED.

Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
MELROSE HIGHLANDS, MASS.

FOR SALE—Bulletins 1 to 56 and 67 to 74 and circulars 1 to 67 of the Bureau of Entomology, all bound. Also bulletins 47 to 66 and from 75 to date and circular 68 to date unbound.

E. MEAD WILCOX, Lincoln, Nebraska.

WANTED—To buy, sell and exchange insects for demonstration and class work in economic entomology and bulletins and reports on all subjects from U. S. Department of Agriculture and Agricultural Experiment Stations, etc.

R. W. BRAUCHER, Kent, Ohio.

WANTED—Specimens of Calosoma beetles from all parts of the world. Write, listing species that can be furnished.

A. F. BURGESS, Melrose Highlands, Mass.

ENTOMOLOGISTS' EMPLOYMENT BUREAU

Conducted by the American Association of Economic Entomologists.

This Bureau will register Entomologists wishing to secure positions. Station Entomologists and institutions desiring to secure assistants are invited to correspond with the undersigned. Enrollment in the Bureau, $2.00. Fee not returnable.

F. L. WASHBURN,
Experiment Station, St Anthony Park, Minn.

FOR SALE—Dyar's List of N. A. Lepidoptera, nicely bound in calf; Aldrich's Cat. of N. A. Diptera, nicely bound in black leather; complete set of Insect Life, nicely bound in red leather; complete set of Technical Series: Nos. 1 to 10, bound in black leather.

JAMES F. ZIMMER, Manistee, Mich.

FOR SALE—The library of the late Harry Pinkus. Price list upon application.

F. C. BISHOPP, Box 208, Dallas, Texas.

Please mention the Journal of Economic Entomology when writing to advertisers.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

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CONTENTS

TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Atlanta, Ga., December 31, 1913, to January 2, 1914

The twenty-sixth annual meeting of the American Association of Economic Entomologists will be held at the Atlanta Medical College, Atlanta, Ga., beginning December 31, 1913, and ending January 2, 1914. The opening session will be called to order at 1.30 p. m. on Wednesday, December 31, when the opening business of the meeting will be transacted and the address of the President will be delivered. The meeting will continue on Thursday morning and afternoon, and the final session will be held at 10 a. m. Friday morning, January 2, 1914.

Sectional Meetings

The meeting of the section of Apiary Inspection will be held at 10 a. m. on Thursday, January 1, at which time the business of the section will be transacted. A meeting of the section of Horticultural Inspection will be held on Thursday at 1.30 p. m., when the papers will be presented and general discussions on matters bearing on Horticultural Inspection will take place.

Other Meetings

The American Association for the Advancement of Science and its affiliated societies will hold meetings throughout the week. The meeting of the Entomological Society of America will be held on Tuesday, December 30, and on Wednesday morning, December 31. The public lecture before that Society will be delivered on Wednesday evening, December 31, by Dr. E. P. Felt, State Entomologist of New York. The subject will be "Gall Insects."

Smoker

A smoker for the visiting Entomologists will be held on Thursday evening. The exact time and place will be announced during the meetings.

Hotel Headquarters

Hotel headquarters for this Association and for the Entomological Society of America have been arranged for at the Ansley Hotel,

corner of Walton and Gore Streets, where rates on the European plan have been secured, ranging from $1.00 to $3.50 per day. Members are urged to make hotel reservations as early as possible, so that there will be no confusion in securing special accommodations.

Railroad Rates

Information in regard to railroad rates has been secured from Dr. L. O. Howard, Permanent Secretary for the American Association for the Advancement of Science.

A railroad rate of one fare and three-fifths for the round trip, on the certificate plan, conditioned upon the presentation at the meeting of not less than 200 certificates, has been granted by the Trunk Line Association. Decision has not yet been received from the New England Passenger Association, but it is believed that it will concur in the same arrangement. The Central and the Eastern Canadian Passenger Associations have refused concessions.

(*As the above reduction in the rate to fare and three-fifths is contingent upon the presentation of a minimum of 200 certificates, as against a minimum of 100 as in previous years, every member traveling from the Trunk Line and the New England Passenger Association territories is urged to procure his certificate. Failure to do this may result in less than 200 certificates being presented and, as a consequence, all other members from this territory will be deprived of the reduced rate on the return trip.*)

The following directions are submitted for the guidance of members traveling from the Trunk Line and the New England Passenger Association territory:

1. Tickets at full fare for the *going* journey may be secured within three days prior to, and during the first three days of the meeting. The advertised dates of the meeting are December 29, 1913, to January 3, 1914, consequently you can obtain your tickets not earlier than December 25, 1913, and not later than December 31, 1913.

From points located at a great distance, from which it takes more than three days to reach Atlanta, going tickets may be purchased on a date which will permit members to reach Atlanta by December 29, 1913.

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of the train.

3. Certificates are not kept at all stations. If you inquire at your station you will find out whether certificates and through tickets can be obtained to the place of meeting. If not obtainable at your

home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket thence, and there purchase through ticket and secure certificate to place of meeting. Be sure that, when purchasing your going ticket, you request a *certificate. Do not make the mistake of asking for a receipt.*

4. On your arrival at the meeting, present your certificate to Mr. F. S. Hazard, assistant secretary, A. A. A. S. It has been arranged that the special agent of the Trunk Line Association will be in attendance at the office of the Permanent Secretary, to validate certificates daily (9 a. m. to 6 p. m.) from Monday, December 29, 1913, to Saturday, January 3, 1914, both dates inclusive. *A fee of 25 cents will be charged at the meeting for each certificate validated.* If you arrive at the meeting and leave for home prior to the special agent's arrival, or if you arrive at the meeting later than January 3, after the special agent has left, you cannot have your certificate validated, and consequently you will not get the benefit of the reduction on the home journey. *No refund of fares will be made on account of failure to have certificate validated.*

If the necessary minimum of 200 certificates is presented, and your certificate is duly validated, you will be entitled, up to and including January 7, 1914, to a continuous passage ticket to your destination via the route over which you made the going journey, at three-fifths of the limited fare.

The Southeastern Passenger Association has published Joint Tariff No. Exc. 5796, I. C. C. No. F 2402 (in effect December 27, 28 and 29, 1913), for excursion fares to Atlanta and return covering practically all railroad lines in its territory. Reasonable concessions are indicated therein.

The Southwestern Passenger Association offers no special rate, but suggests that members take advantage of the regular Christmas Holiday excursion rates to points in the Southeast.

The Western Passenger Association states that the fares in a large part of its territory are now on the basis of two cents a mile, which affords practically the same reduction as was formerly granted on the certificate plan.

From the States of California, Nevada, Oregon, Washington, and West of and including Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine-Months Tourist fares, approximating two cents a mile in each direction. The nine-months fares

apply to the eastern gateways of the Transcontinental territory which are:

Atchison, Kansas,	New Orleans, Louisiana,
Chicago, Illinois,	Omaha, Nebraska,
Colorado Springs, Colorado,	Pueblo, Colorado,
Council Bluffs, Iowa,	Memphis, Tennessee,
Denver, Colorado,	Mineola, Texas,
Fort Worth, Texas,	Minneapolis, Minnesota,
Houston, Texas,	St. Joseph, Missouri,
Kansas City, Missouri,	St. Louis, Missouri,
Leavenworth, Kansas,	St. Paul, Minnesota.

Station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine-months tickets in rebuying through to Atlanta.

Proportionately higher fares are made to principal Atlantic seaboard points and to interior points such as New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Washington, D. C.; Boston, Mass.; Montreal, Quebec; Albany, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Detroit, Mich.; Toronto, Ontario; Cincinnati, Ohio; Indianapolis, Ind.; Atlanta, Ga., etc.

The nine-months fares do not apply to intermediate or interior points, but only to what are known as the eastern gateways of the Association, such as those named, including also Colorado Common Points. Should it happen that delegates apply at a station on the Pacific Coast from which the nine-months fare is not in effect, which may be the case at very small, unimportant stations, the agent will cheerfully ascertain and advise them the nearest point to his station from which such fare does apply.

It is suggested that advantage be taken of such excursion fares as may be in effect at the time of the meeting. Members should, therefore, consult their local ticket agents regarding routes and rates. Parlor and sleeping car accommodations should be reserved in advance.

Official Buttons

The official button of this Association will be supplied to all members whose dues are paid including dues for the year 1914. This will be furnished at the meeting on application to the Secretary.

Program

Wednesday, December 31, 1913, 1.30 p. m.

Report of Secretary.

Report of executive committee, by President Parrott.

Report of employment bureau, by F. L. Washburn, St. Anthony Park, Minn.

Report of committee on nomenclature, by Herbert Osborn, Columbus, Ohio.

Report of committee on entomological investigations, by T. J. Headlee, New Brunswick, N. J.

Report of committee on incorporation, by E. P. Felt, Albany, N. Y.

Appointment of committees.

Miscellaneous business.

Reference to committee for consideration of the proposed amendment to the constitution.

In article 3, section 1, "The officers shall consist of a president, two vice-presidents, who shall be elected annually and a secretary who shall be elected for a term of three years . . ."

Amend by striking out the words, "Two vice-presidents," and insert instead the words, "one vice-president and an additional vice-president for each section."

New business.

Annual address of the President, P. J. Parrott, Geneva, N. Y. "The Growth and Organization of Applied Entomology in the United States."

Reading of Papers

"Today's Work in Applied Entomology," by F. L. Washburn, St. Anthony Park, Minn. (12 minutes.)

A review of recent work in economic entomology.

"County Organization in the Boll Weevil Campaign," by W. E. Hinds, Auburn, Ala. (10 minutes.)

Information concerning organization of county agricultural advisory committees, coördinating and promoting all movements for rural betterment and bringing merchants and farmers *et al.* into helpful coöperation.

"Entomological Work in Missouri," by Leonard Haseman, Columbia, Mo. (10 minutes.)

A brief discussion of the work which the Department of Entomology is now doing and our plans for extending the work in the future.

"Grasshopper Control Work in Western Kansas," by George A. Dean, Manhattan, Kans. Lantern. (15 minutes.)

A brief review of the Grasshopper situation during the last three years. The serious outbreak of the summer of 1913. The organization for a systematic fight. The distribution of 1875 tons of poisoned bran mash. The result of the campaign.

"Report of Field Work on the Southern Corn Bill Bug, *Sphenophorus callosus*," by Z. P. Metcalf, Raleigh, N. C. (5 minutes.)

"The present Organization and Methods used by the Bureau of Entomology on the Gipsy Moth Work," by A. F. Burgess, Melrose Highlands, Mass. (15 minutes.)

"A Simple and Economical Method of Filing Entomological Correspondence," by Wilmon Newell, College Station, Texas. (10 minutes.)

Ordinary pasteboard letter files are used for filing and the correspondence handled by subjects in such a manner as to eliminate the use of filing cabinets, index cards, folders, and transfer cases. The file is self-indexing and has been found practical andefficient in handling correspondence for the past four years.

"Some New Insects of Economic Importance in the State of Washington," by M. A. Yothers, Pullman, Wash. (10 minutes.)

A brief discussion of the occurrence of new species of "Weevils" found in destructive numbers on fruit trees in the arid regions of the state.

Adjournment.

Program

Thursday, January 1, 10 a. m.

Discussion of the Presidential Address

Reading of Papers

"Can Insects become Immune to Spraying?" by A. L. Melander, Pullman, Wash. (12 minutes.)

"The Reaction of Sugar Maples to Miscible Oils," by E. P. Felt, Albany, N. Y. (7 minutes.)

"Some Factors Affecting Results in the Use of High Temperature for the Control of Insects Injuring Cereal Products," by W. H. Goodwin, Wooster, Ohio. (10 minutes.)

"The Relation of Temperature to Insect Development," by L. M. Peairs, Morgantown, W. Va. (10 minutes.)

"Soil Fumigation for Subterranean Insects," by J. A. Hyslop, Washington, D. C. (10 minutes.)

"Further Experience with an Insectary," by W. C. O'Kane, Durham, N. H. (10 minutes.)

Some difficulties experienced, changes made, cost.

"Life History of the Bee Moth or Wax Worm," by F. B. Paddock College Station, Texas. (10 minutes.)

A brief review of the life history of this insect as established by experimental work at College Station, Texas. There are in this latitude three generations. Carbon bisulfide has been found to be very effective in the control of this pest.

"Oviposition of two Apple Pests," by Glenn W. Herrick, Ithaca, N. Y. (10 minutes.)

"The lesser Peach Borer, *Sesia pictipes*," by H. A. Gossard, Wooster, Ohio. (5 minutes.)

Life history studies in the Lake Erie fruit belt.

"Some notes on the Box Leaf Miner," by A. E. Stene, Kingston, R. I. (10 minutes.)

Notes on the appearance of this insect in Rhode Island. Its present distribution and observations on its life history and methods of control.

"Notes on two new Pests of the Currant and Gooseberry," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

Notes on the life history, economic importance and means of controlling a weevil, injuring fruit of the currant and a species of thrips injuring the foliage of the currant and gooseberry.

Adjournment.

Program

Thursday, January 1, 1.30 p. m.

Reading of Papers

"The Occurrence of the Warble Fly, *Hypoderma bovis*, in Canada," by C. Gordon Hewitt, Ottawa, Canada. (5 minutes.)

"Control of the Onion Thrips and Onion Maggot," by H. T. Fernald, Amherst, Mass. (10 minutes.)

"A New Destructive Cutworm of the Genus Paragrotis Occurring in Western Canada," by Arthur Gibson, Ottawa, Canada. (5 minutes.)

Preliminary note on the occurrence and destructive nature of a new enemy of cereals.

"Reducing Insect Injuries on Stored Corn," by W. E. Hinds, Auburn, Ala. (15 minutes.)

Outlining factors predisposing to injury, extent of injury, methods of preventing and reducing it.

"The Western Corn Root Worm in the South," by Geo. G. Ainslie, Nashville, Tenn. (5 minutes.)

"Thrips attacking Oats," by C. Gordon Hewitt, Ottawa, Canada. (10 minutes.)

"The Life History of the Green Soldier Bug, *Nezara hilaris*," by R. D. Whitmarsh, Wooster, Ohio. (5 minutes.)

"Experiments against the Tarnished Plant Bug as an Enemy of Peach Nursery Stock," by C. R. Crosby, Ithaca, N. Y. (10 minutes.)

"Further Data on the Control of the Fruit-tree Leaf Roller," by Glenn W. Herrick, Ithaca, N. Y. (10 minutes.)

"The Egg Laying Habits of the Pecan Twig Girdler, *Oncideres cingulatus* Say," by C. L. Metcalf, Raleigh, N. C. Lantern. (7 minutes.)

"Notes on Forest Insects," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Notes on the Life History, Distribution and Efficiency of the Egg Parasite of the Chinch Bug," by J. W. McColloch, Manhattan, Kans. (10 minutes.)

This paper will deal with the length of the life cycle, number of broods, habits, distribution in Kansas, and percentage of parasitism at various times during the summer.

"The Parasites of the San José Scale in New York—Species and Distribution," by H. E. Hodgkiss and P. J. Parrott, Geneva, N. Y. (15 minutes.)

"Notes on Parasites in the Hawaiian Islands," by Otto H. Swezey, Honolulu, Hawaii. (10 minutes.)

"Relation of the Number of Larval Stages to the Development of Male and Female Gipsy Moths," by F. H. Mosher, Melrose Highlands, Mass. (10 minutes.)

Adjournment.

Program

Friday, January 2, 10 a. m.

Reading of Papers

"The Education of the Entomologists in the Service of the United States Department of Agriculture," by L. O. Howard, Washington, D. C. (15 minutes.)

"Observations on Insect Borne Diseases in Ecuador and Peru," by Charles T. Brues, Forest Hills, Boston, Mass. Lantern. (15 minutes.)

"Anti-Mosquito Work in New Jersey," by T. J. Headlee, New Brunswick, N. J. Lantern. (15 minutes.)

"A Remarkable Outbreak of *Culex pipiens* Linn." by W. E. Britton, New Haven, Conn. (10 minutes.)

Species appearing in West River, New Haven, Conn., where fish had been killed.

"Further Observations on the Breeding Habits of the House Fly and its Control," by C. Gordon Hewitt, Ottawa, Canada. (15 minutes.)

"Experiments With House Fly Baits and Poisons," by A. W. Morrill, Phoenix, Ariz. (10 minutes.)

Tests of the various fly trap baits and poisons used for house flies to determine their relative attractiveness and effectiveness.

Final Business

Report of committee on auditing.
Report of committee on resolutions.
Report of committee on membership.
Report of other committees.
Nomination of Journal officers by Advisory Committee.
Report of committee on nominations.
Election of officers.
Miscellaneous business.
Fixing the time and place of next meeting.
Final adjournment.

SECTION OF APIARY INSPECTION

Wilmon Newell, *Chairman.* E. F. Phillips, *Secretary.*

Program

Thursday, January 1, 10.30 a. m.

Address by the Chairman, Wilmon Newell, College Station, Texas.

Reading of Papers and Discussions

"Bee-keeping and Apiary Inspection in Missouri," by Leonard Haseman, Columbia, Mo. (15 minutes.)

A brief report of the work of the State Apiary Inspector and the work which the Department of Entomology has undertaken.

The reading of papers will be followed by a discussion of Apiary Inspection in the United States.

Subject for discussion: "The Relation of the Inspection of Apiaries to other Factors for the Education of the Beekeeper."

Other papers which may be prepared by the members can be added to the program at the time of the meeting by making arrangements with the Secretary of the section.

Transaction of business.

Election of Section Secretary.

SECTION ON HORTICULTURAL INSPECTION

E. L. Worsham, *Chairman.* J. G. Sanders, *Secretary.*

Program

Thursday, January 1, 1.30 p. m.

Address by the Chairman, E. L. Worsham, Atlanta, Ga.

Reading of Papers

"Nursery and Orchard Inspection Work in Missouri," by Leonard Haseman, Columbia, Mo. (15 minutes).

A discussion of the history of nursery inspection and inspection laws in Missouri and plans for carrying out the recently enacted state law.

"Some Problems Arising from the Administration of the Minnesota Inspection Law," by F. L. Washburn and A. J. Spangler, St. Anthony Park, Minn.

"The Gipsy Moth and Brown-Tail Moth Quarantine in New England," by D. M. Rogers, Boston, Mass.

General discussion of horticultural inspection problems.

It is expected that the Federal Horticultural Board will be represented at this meeting and that a report on the work of the Board will be presented.

Other papers can be added to the program by making arrangements with the Secretary of the section.

Transaction of business and election of Section Secretary.

A. F. Burgess, *Secretary,*
Melrose Highlands, Mass.

P. J. Parrott, *President,*
Geneva, N. Y.

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THE RHINOCEROS BEETLE (ORYCTES RHINOCEROS L.) IN SAMOA

By R. W. Doane, *Stanford University, California*

The following notes are based on studies made by the author in Samoa during May, June and July, 1913.

The rhinoceros beetle, *Oryctes rhinoceros* L., has long been known as a more or less serious pest of coconut trees in many tropical countries. It is gradually extending its range and wherever it gains a foothold in a new country its ravages cause much worry and usually great financial loss.

The island of Upolu, German Samoa, is one of the recent places to suffer from the introduction of this pest. Its presence there was first noticed in the fall of 1910 when the ragged condition of some of the trees near the customs house in Apia caused an investigation to be made. As soon as their characteristic work was recognized there was evidence on every hand to show that the beetles were already well established there. Within a restricted area many of the coconut trees were badly injured and the larvæ were found abundantly in decaying wood, manure and other refuse. Just how the beetle was introduced into Samoa will probably never be known, but it is quite likely that young larvæ were brought in with soil and vegetable refuse packed around the stumps of rubber trees imported from Ceylon.

Unfortunately systematic attempts were not made to exterminate the pest when first discovered. Certain control measures were adopted but the fight was not carried on vigorously enough to keep the beetle from gradually spreading to all the districts near Apia and later to more distant parts of the island.

The prevailing northeast trade-wind has been a determining factor in the direction of the spread of the insect, the districts to the windward of Apia showing comparatively little damage. In the other direction practically all of the plantations are more or less affected, the infestation having passed around the end of the island and for

some distance up the other side. The beetle has also very recently appeared in limited numbers in the island of Savaii where it has probably been carried by the natives who are constantly passing back and forth, carrying quantities of mats, food and many other articles in which the beetles and larvæ or eggs might easily be transported.

In districts where infestation is the worst, hundreds of trees are being killed on many of the plantations and others are being so badly injured that, even should they recover, it will be some years before they will have a good crop of nuts.

As the beetles attack the most vital part of the tree, the succulent crown, one or two will quickly kill a young tree. Older trees are able to sustain greater loss but even a few beetles in them will soon make them unproductive, and, as the trees are sometimes attacked by as many as ten or fifteen beetles at once, even the sturdiest trees may succumb. The beetles usually attack the tree close to the base of some of the leaves, between the base of a leaf and the tree, or between the bases of two leaves. They are thus enabled to use their legs to brace themselves firmly while beginning their burrow. The strong curved horn on the head is also called into use as the beetles gnaw their way through the tough fiber. The head is lowered and the horn thrust into the fiber, then as the head is raised the body is drawn forward. As the beetles are usually an inch and a half long and about an inch in diameter the holes that they make in the base of the larger leaves are very conspicuous, particularly as the older leaves die and hang down. On their way toward the center of the plant the beetles usually cut through some of the young leaves, the pinnæ of which are still folded closely along the midrib. As these leaves unfold they present a very characteristic appearance looking as if they had been cut by shears. Having reached the tender heart of the tree the beetles feed on it probably for some weeks, often destroying much or all of it, thus killing the tree.

The beetles swallow but little or none of the fiber through which they bore. A study of their mouthparts shows that they are less fitted for biting and chewing than they are for boring and tearing and crushing. The inner surfaces of the heavy mandibles do not meet except at the extreme base, the triangular space between them being filled by the maxillæ and the tip of the labium. The outer margins of the maxillæ and the labium are furnished with a dense fringe of rather long stiff bristles which, with similar bristles on the labrum, serve as a sieve for straining out the particles of plant tissue that are torn loose by the mandibles and the two tooth-like projections above them. The mandibles and their projections tear the tissue of the plant into shreds and the juice which is crushed from it is strained

through the bristles with which the mouth is surrounded. Examination of the alimentary canal of many beetles failed to show any of the plant fiber. The importance of this will be seen when we come to consider control measures.

The life history of this insect has not as yet been thoroughly worked out but in Samoa it probably takes it at least a year to complete its development. The eggs, which are laid in batches of ten to thirty, hatch in a very short time and the larvæ feed for several weeks, possibly for some months. In Samoa the larvæ are found most commonly in old decaying coconut logs or stumps, in places where these occur, but other rotting wood or decaying vegetable matter of any kind seems to furnish an abundance of food. The cacao pods that are often left in piles in the field furnish excellent breeding places. The larvæ are not commonly found in the living trees, but, if the crown is badly injured and contains much decaying matter, they may sometimes occur there.

One tree about twelve years old that, when standing, appeared to be only moderately injured was cut down and found to contain fifteen beetles, twenty-four larvæ, one third to one half grown, three smaller larvæ and a few eggs. A few larvæ and eggs were also found in other trees so that it is possible that, when the breeding places on the ground are not so readily available, more of the beetles will lay their eggs in the injured trees.

Unless a special search is made for them the pupæ are rarely seen and they are never found in any considerable numbers. Those that are found are usually in well-formed cells in portions of the log that are a little firmer than that in which the larvæ commonly work. Many of the larvæ probably enter the ground and pupate some distance below the surface. The pupal stage lasts for about ten days or two weeks. It is very difficult to rear the beetles from pupæ that have been taken from their cells. Not only are the pupæ very easily injured but they do not seem to be able to live except under the most favorable conditions. After the beetles issue they remain in the logs for a few days, waiting for the body wall to harden. Their flight is slow, heavy and, in the breeding cages at least, not very long sustained. In a cage 8 x 8 x 16 feet the longest flight noted was two and one half minutes. They probably would fly for a much longer time outside. They fly only at night, and sometimes come to lights, but even the brightest lights do not attract them in great enough numbers to be of any value in control work.

In Samoa many control measures have been tried. In the effort to protect the trees from attack, many substances which were supposed to act as repellants have been used. Our observations and experi-

ments seem to show that tar is the most effective of these, but even its use gives only a small measure of protection. Many planters simply painted the tar on the outside of the base of some of the leaves, but this soon became dry and hard and of little value. As kerosene was often added to the tar more or less damage to the tree often resulted and, in some cases, when equal parts of kerosene and tar were used, many trees were killed. As the kerosene adds little or nothing to the repellant value of the tar and as it is not needed for a thinner, there is no excuse for using it in this way. In experimenting with this material many young trees, ten to fifteen years old, were thoroughly cleaned by cutting out all the dead leaves, flower stems, etc., and then examining the tree carefully to see whether any beetles were already in it. Sometimes it was necessary to cut away some of the green leaves also before the beetles could be reached. A rather stiff wire with a hook or barb on the end of it was often found convenient for spearing the beetles and pulling them from their holes when they were deep in the tree. If the tree was badly infested with beetles it was often found necessary to remove nearly all of the old leaves before it could be thoroughly cleaned. After the beetles were removed all of the new-cut surfaces and the inner side of the base of the leaves were painted with tar, particular care being taken to treat thoroughly all of the holes and any open spaces where the beetles might enter. Alternate trees cleaned in the same way, but not treated with tar, and other trees from which few or none of the leaves were cut, were left as checks. An examination forty days later showed that the trees treated with the tar had fewer beetles in them than the check trees had, but the fact that many of the tarred trees were attacked by one or more beetles shows that this treatment offers only a small measure of relief.

Other trees were treated with lysol and some with lysol mixed with the tar, but as many of the leaves, especially the young leaves, were badly injured it was found that this substance could not be used for this purpose.

Coarse beach sand was poured into the crowns of a few trees, care being taken that plenty lodged at the bases of all of the leaves. Still other trees were treated in the same way with very fine sharp sand. When the trees were last examined only one had been attacked by the beetles, but not enough time had elapsed to make the experiment of any value. A little white arsenic was mixed with the sand in some of the trees. When such a mixture touched the young leaves they were usually more or less injured.

A few trees were dusted thoroughly with white arsenic, others with Paris green, still others were treated with these arsenicals mixed

in water. Such trees were covered with a netting under which a few beetles were placed. A few days later three beetles were found dead in the nets; three had bored into the trees and were apparently unaffected by the arsenic, but most of the beetles had escaped by tearing holes in the netting. In order that these arsenical sprays might be given a thorough test the crowns were cut from a few trees and the leaves all trimmed off. This part of the tree was very thoroughly treated, great care being taken that all exposed surfaces received some of the arsenic. They were then placed in a large cage where a few beetles were confined. Sometimes as many as four out of ten beetles would be found dead in the cage the next day, but many of the beetles entered the tree and were apparently unharmed by the presence of the arsenic. No tests were made to determine whether the dead beetles were killed by the arsenic. It was quite common to find some dead beetles in the cage even when the trees that were placed therein were not treated. The results of these experiments are such as we would expect after studying the mouth-parts and feeding habits of the beetle, for little or none of the arsenic would find its way into the stomach unless the leaf or stem fiber was swallowed.

In an effort to kill the beetles in the trees, without cutting the tree as much as was usually necessary, a little carbon bisulphide was poured into some of the holes after the mass of chewed-up fibres had been removed. The beetles were always quickly killed, but, unfortunately, the trees were always badly injured by the liquid and young trees were often killed.

During the last two years a long series of experiments have been made in an attempt to attract the beetles to various kinds of traps to lay their eggs. The trap very commonly used is made of pieces of rotting logs piled in a neat pile and partly covered with earth. Cacao pods, manure and other decaying vegetable matter adds to the efficiency of the trap. If no other breeding places are convenient the beetles may be attracted to these traps in considerable numbers. At regular intervals, usually every six or eight weeks, these traps are examined and the rotting logs split up and the beetles, larvæ and eggs found therein destroyed. If this work is carefully done it is quite effective on well-cleaned plantations, but it is expensive and requires close supervision. If the traps are made of small pieces of well-rotted wood, cacao pods or other decaying vegetable matter mixed with a little earth, the whole mass may be treated successfully with carbon bisulphide by pouring a little of the liquid in holes in various places over the trap. This will kill all of the beetles and larvæ except those

that are well protected in the wood. But this treatment is expensive and only successful when the traps are carefully made.

For the present at least then, the most effective method of control is to destroy the breeding places of the beetle. In an old well-kept plantation this is easily done, but on new plantations the problem is a very serious one, for, without very heavy expense, it takes a long time to burn or destroy all the old logs and stumps. Coconuts and often cacao trees are usually planted within one or two years after the bush land has been first cut over and while many of the larger trees are still lying unburned on the ground. As some of the bush trees are very hard they decay slowly and it is sometimes several years before they can be cut up or burned easily. As long as any of these decaying trees are in the field they are a constant menace to the surrounding coconut trees. Plantations near wild bush land have the dead trees there to contend with also.

Piles of cacao pods are favorite breeding places for the beetles, and when these are buried, as they often are in an effort to check the spread of the cacao canker, they become even more dangerous for the beetles readily find them and breed there in great numbers. The pods should be burned soon after they are opened unless some method of treating them can be found whereby they will not endanger the cacao trees or serve as breeding places for the beetle.

Realizing that it is impossible, because of lack of funds or labor, for some of the planters to clean up the land the local government has very wisely begun to aid them in this work. This is as it should be. This insect is a common foe and it is just as much the function of the government to protect its subjects from it as it is to protect them from invasion by another nation. The problem is largely a question of labor and will probably be satisfactorily solved only when the government can put enough men on the infested plantations to clean them as they should be.

Careful searching and breeding experiments have failed to reveal any insect parasite of this beetle in Samoa, nor is any such natural enemy known to occur in other countries. It is quite possible, however, that a careful search in places where the beetle has long been established may reveal some important enemies. Dr. Friederichs, zoölogist and plant pathologist for Samoa, has been working for some months with a fungus disease that is found attacking a very few of the larvæ on some of the plantations. Under laboratory conditions this can be made to do very good work but so far it has spread too slowly in the field to do very much good. It is possible that further experiments may teach us how to make this a valuable ally in our fight against this important pest.

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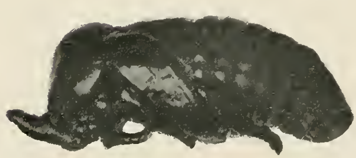

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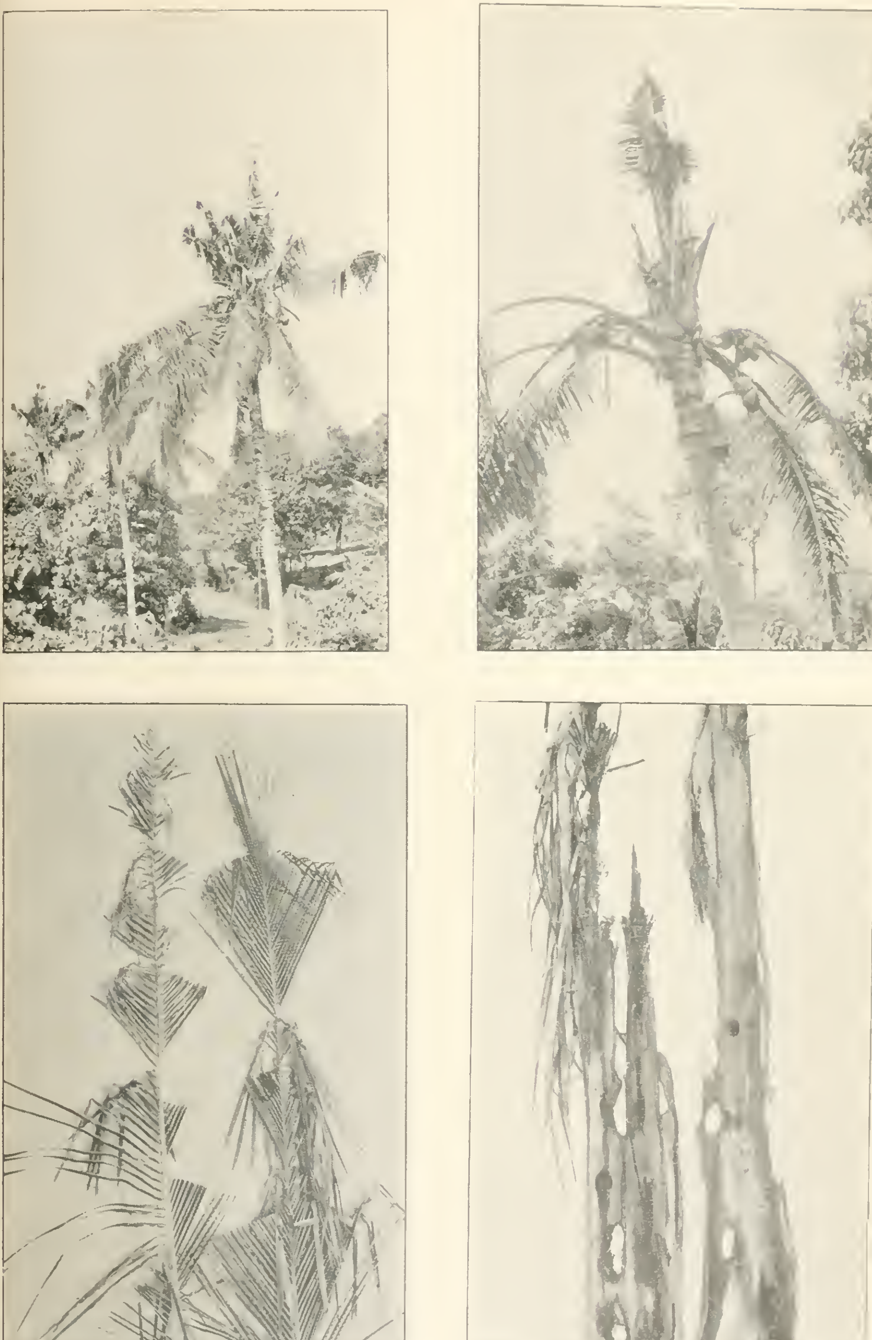
4

RHINOCEROS BEETLE

1, *Oryctes rhinoceros* L.; 2, Larva of same; 3, Pupa of same; 4, Two larvæ of same that have been killed by a fungus.
(All natural size.)



1 2 3 4

1, Coconut trees affected by *Oryctes rhinoceros* L.; 2, Closer view of a badly affected tree. 3, Leaves cut by the beetle before unfolding; 4, Base of leaves injured by beetles.

REPORT ON A TRIP TO DEMERARA, TRINIDAD AND BARBADOS DURING THE WINTER OF 1913

By George N. Wolcott.[1]

Late in the autumn of 1912, I made a trip to Demerara, Trinidad, and Barbados to investigate certain aspects of the cane insect problems in those countries for the Porto Rican Board of Agriculture, and in the interest of the sugar planters of Porto Rico.

It would not have been possible for me unaided to have made observations of much value, had I not received the heartiest coöperation from various persons, particularly the Entomologists of the countries visited. Especial mention should be made of the assistance rendered by Mr. J. B. Harrison, Director of the Botanical Gardens, Mr. G. E. Bodkin, Government Economic Biologist and Mr. J. J. Quelch, Entomologist for the cane growers, of Demerara; Mr. F. W. Urich, Entomologist of the Board of Agriculture at Trinidad; Mr. J. R. Bovell, Director of the Local Department of Agriculture; Mr. Wm. Nowell, the Assistant Director, Entomologist and Mycologist, and Mr. H. A. Ballou, Entomologist of the Imperial Department of Agriculture for the Lesser Antilles, at Barbados.

The methods of growing cane, and the conditions of labor, soil and climate are different from those common in the southern United States. It will be necessary, therefore, to tell something of them before one can obtain an appreciation of the injury caused by the pests of cane and the effectiveness of the control measures adopted.

In Demerara, all the cultivated area in cane consists of a strip of land, varying in width from one to three or four miles, running along the coast—sometimes close to the ocean and only protected from it by the barriers, similar to the levees in Louisiana, which protect the fields from the overflow of the rivers, in other cases separated by miles of low marsh land from the sea. Although in recent years there has been a considerable consolidation of the estates, the typical cane estate consists of a narrow strip of land, sometimes only a quarter of a mile wide, which runs back from the ocean into the wild, uncultivated and often unexplored interior. The typical arrangement is a road extending from the mill back through the cultivated area, on one or both sides of which is the main canal or ditch—fifteen or twenty feet wide. Each ditch has numerous side branches at regular intervals, leading back between the fields. The estate is entirely dependent upon these ditches for the transportation of the cane from

[1] Published by permission of J. T. Crawley, Chairman of the Science Committee of the Board of Commissioners of Agriculture of Porto Rico.

the fields to the mill. After the cane is cut, it is placed in steel barges, which are towed along the canal and finally pass into the mill, where the cane is lifted by slings on to the carrier.

The cane is grown in beds about thirty feet wide. These beds are separated by small ditches one to two feet wide. The ditching is necessary as the soil is heavy and the drainage poor. The rows of cane usually run crosswise of the bed, but in some fields where the land is not quite so heavy and the drainage is consequently better, the rows of cane are lengthwise of the bed. This arrangement might permit of mechanical cultivation which is not possible where the cane is grown in short rows.

Labor is one of the most serious problems on the plantations as the native Indians will not work, the negroes are unreliable and it is only the indentured coolie labor from India that can be relied upon. These men must work for five years without remuneration, the only expense to the employer being the cost of the laborer's passage from India and his subsistence. During the next five years, the coolie receives the average market wage per day, minus one shilling (24c.) but must pay this shilling even on days that he does not work. At the end of ten years he is free to return to India, or move to town, or to any other estate. Coolies newly arrived from India can not be used for the hand control of insect pests because of their religious scruples, but boys of the second generation, born in the colony, prefer this work to any other.

In Trinidad the labor supply is much as in Demerara, as the coolies do most of the work, although sometimes natives and negroes are seen at work in the fields.

The cane in Trinidad is grown in a comparatively restricted area along the west coast between Port-of-Spain and San Fernando. The land is better drained, higher and of better texture than in Demerara. The cane is grown in level beds with the rows lengthwise of the bed, but despite the fact that the drainage ditches do not cut up the fields any more than in Louisiana, mechanical cultivation is seldom attempted.

The agricultural practice most noticeable is that of abandoning cane fields that are not producing a profitable tonnage. Even on the best managed and more profitable estates, one sees fields abandoned, growing up to weeds and grass, and pastured to oxen, with a few stalks of cane remaining to show what was the former crop. Upon the froghopper, *Tomaspis varia* Fabr., the most serious insect pest of cane in Trinidad, a bug that stunts or kills the cane by sucking the juice from the roots, is placed the blame for the abandonment of these fields. It is easy to see, however, that in an industry as un-

profitable as is sugar production at present in Trinidad, the tendency would be to cultivate only the more productive fields. How unfortunate and undesirable this practice is in connection with attempting to control the insect and fungus pests of cane will be discussed later.

In Barbados, the methods in vogue are the result of very cheap and abundant labor, the high price of land and the nature of the water supply. Everything is done on the most minute scale and by most antiquated and laborious methods. The island itself is small, and two thirds of the entire area is devoted to the cultivation of sugar cane. Modern factories are unknown and the cane is ground by small mills, which, in the majority of cases are driven by windmills. Most of the windmills are of the picturesque four-armed Dutch type. In some cases the rollers are vertical, although most of them are horizontal, and the cane is fed to the crushers by hand. The interior of the factory is very clean and sanitary, but everywhere manual labor is used instead of machines. Two men work the big ladle which transfers the juice from one evaporating pan to another and the concentrated juice is carried to the centrifugals in pails on the heads of negro women.

Another result of the cheap labor is that it is possible to cultivate the cane much better and cleaner than is done anywhere else. The entire absence of weeds is indeed remarkable and the more so when one considers that although the straight rows seem to invite mechanical cultivation, it is never attempted. The soil is black and of very good texture, but thin in most places. The coraline rock outcrops in many places and is never far beneath the soil. Rainfall in Barbados is comparatively slight and were it not for the coral rock, which acts as a sponge, conserving the rainfall and soaking up water from the sea, agriculture would be impossible. Capillarity brings the water up in to the soil from the surface of the rock and even in the dryest seasons the soil is moist at the depth of a foot. Soil moisture is further conserved by a thick mulch of cane trash, which is placed about all young plant cane. The wind often blows it away and it is carefully put back in place by the laborers.

From this short outline of the varying conditions under which cane is grown in Demerara, Trinidad and Barbados, it might well be expected to find a similar diversity in the insect pests affecting the cane. Such, in general, is the case. The cosmopolitan *Diatræa saccharalis* Fabr., however, occurs in all the countries and does more injury to the stalk than any other insect. *Pseudococcus calceolariæ* Mask., is also a common pest on cane, but its injury is not so generally considered serious.

In Demerara, the smaller moth borer, *Diatræa saccharalis* Fabr., and the closely allied species, *D. lineolata* Walker and *D. canella*

Hampson, are undoubtedly the most serious pests of cane. The importance of the smaller moth borer is recognized by the planters and managers, and most strenuous measures have been adopted for its control. On practically every estate there are gangs of boys, sometimes as many as fifty in a gang, who do nothing else the year round but cut out the dead hearts which have been caused in the young cane shoots by the *Diatræa* larvæ. The boys receive 6 cents per 100 for the larvæ and every effort is made to make the work thorough and systematic. There is a tacit understanding between the boys, however, that the collection of 700 is a fair day's work (and this represents more than a fair day's wage for a man) and they make no particular effort to collect more than about that number. It shows how serious the pest is, that the boys have no difficulty in collecting this number of larvæ day after day. The first impression one receives on going into a field of cane ready to be cut, is what an enormous amount of damaged cane is present. It is not at all difficult to find stalks with *Diatræa* holes and burrows in every internode, and it is practically impossible to find a single stalk of uninjured cane. For the ordinary varieties of cane this would mean that there would be practically nothing left worth grinding, but in Demerara, this problem has been met, though not solved, by the almost universal use of a local seedling cane, Demerara, 625. Although not highly resistant to *Diatræa,* it is more so than the older varieties and it is a valuable cane to plant for that reason, despite its low sucrose content.

The problem of controlling *Diatræa* is most seriously complicated in Demerara by the wet and dry seasons. There are always two and sometimes four wet seasons, and of course as many dry. Cane is cut towards the end of each dry season and seed cane will be planted at each wet season. As it takes from a year to eighteen months for the maturing of a crop, it can readily be seen that cane in all stages of growth is present on a single estate at all times. This means that there is always present, as partly or fully grown cane, a continuous and abundant source of re-infestation of the fields of young cane from which all the dead hearts have been cut out. Moths will fly out a hundred yards or more from the older cane, and more especially from cane that has been cut, depositing eggs on the young cane from which all the dead hearts have just been cut out, and in two or three weeks, the infestation will be as heavy as though no control had been attempted.

In addition to the attempted control of *Diatræa* by artificial means, the numbers of the pest are still further greatly reduced by parasites, four of which are present in Demerara. Two are parasites of the egg

and two of the larvæ. The cosmopolitan and ubiquitous *Trichogramma minutum* (*pretiosa*) Riley is everywhere abundant, and it is always easy to find egg clusters parasitized—indeed it is sometimes difficult to find clusters not parasitized. This high ratio of parasitism may be more apparent than real, as the black parasitized egg masses are very easily detected, but those not parasitized, being semi-transparent and light yellow in color, are much more difficult to see and not so many are collected. Another egg parasite, probably *Telenomus* sp., is also present in considerable numbers. A characteristic habit of *Telenomus* which makes it of much less value as a parasite, is that of neglecting to infest all the eggs in a cluster. Often as many as four or five eggs are thus allowed to hatch.

The adults of *Iphiaulax* sp., the braconid larval parasite, are quite noticeable in the field, as the red thorax and abdomen, very long black ovipositor and black and yellow wings make them conspicuous. The boys cutting out dead hearts often find six or seven larvæ or cocoons of this parasite in a day. This means almost exactly 1 per cent. of parasitism. Mr. Bodkin has also bred Tachinid flies from puparia which the boys had collected in dead hearts, but these are much less common than the *Iphiaulax*.

In addition to having the boys cut out dead hearts, they are also paid one half cent each for *Diatræa* egg mass that has not turned black or red, which are considered to be nonparasitized, but this practice is by no means general. Most managers are theoretically in favor of it, because it removes the insect before it has done any injury, but the practical impossibility of getting all, or even a large part of the clusters, makes it impractical except in connection with the cutting out of dead hearts. The cost of keeping large gangs in the field the year round is very considerable, for the boys who cut out the dead hearts have work throughout the year as it takes three or four weeks to go over an estate thoroughly and they immediately recommence. It is difficult to say whether the cutting out of dead hearts does control *Diatræa* in a measure or not, but one is safe in saying that *Diatræa* injury would be much more severe, were it not done. It certainly is true that to be effective, it must be well done, and when negro women and girls are used instead of the coolie boys, the value of their work is problematical, for in addition to failing to cut out all the dead hearts, the women also cut perfectly healthy shoots.[1]

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[1] The coolie boys, far from being so stupid as to cut healthy shoots, are so bright that they have been known to substitute the larvæ of wasps for the *Diatræa* larvæ, which they somewhat resemble in general appearance and are, of course, much more easy to obtain in large numbers. The unsuspecting overseers, who look over what the boys have collected, are none too observant, and often the deception passes.

I wish to emphasize the fact that *Diatræa* is *NOT* controlled in Demerara, by the two egg parasites, *Trichogramma* and *Telenomus*, the larval parasites, the cutting out of dead hearts, the collecting of nonparasitized egg masses, clean cultivation, the burning or not burning of trash, all combined.

Mr. J. J. Quelch, the Entomologist for the planters, tells me that the one measure that can be adopted which will in part make up for the lack in Demerara of a season when no partially grown or large cane is present as a source of re-infestation of the young cane, is the simultaneous planting of enormous blocks of cane. It is the indiscriminate scattering of the fields of all ages of cane on an estate that makes possible the rapid and easy infestation of young cane. *Diatræa* moths are not long distance flyers and when all young cane is in a large block away from the older cane, it will not be so readily infested. This is undoubtedly a very ambitious plan of campaign against the smaller moth borer, but the amount and seriousness of the injury and the comparative ineffectiveness of the methods of control, now used, make radical measures necessary.

The only other serious pest of cane in Demerara is the giant moth borer, *Castnia licus* Fabr. Several years ago the injury caused by this pest was very great, but the systematic warfare commenced against it has lessened its numbers to such an extent that its depredations are now of somewhat minor importance. The eggs of the moth are deposited in the earth or in trash on the ground. The young larva enters the cane at the surface of the ground and burrows down into the root and also up into the stalk. The larvæ grow to be four inches or more in length and half an inch in diameter. It may well be imagined how serious is the injury that one larva does to a stalk of cane. When the cane is young one individual will often kill several stalks and one can readily see the injury in the field even before the cane is cut. Older cane, however, is not killed by *Castnia*, for the larva eats only the sweet pithy inside of the lower portions of the cane, and the growth at the tip is not appreciably checked. It is only when the cane is cut that one can accurately determine the extent of the injury, as then the large holes in the stubble are most noticeable, or by watching the cane in the cane cars the amount of infestation is easily estimated.

Despite the large amount of injury the giant moth borer is capable of producing, it is an indication of poor estate management if it is allowed to cause serious trouble, as there are several entirely practical measures of control. A measure that naturally suggests itself is the capture of the adults. These big day-flying moths are a common sight in the cane fields, being most abundant on bright days between ten

in the morning and noon. They are usually seen in the fields of young ratoon cane, where the eggs may be deposited. No baits seem to have any particular attraction for them, but the moths are not particularly difficult to catch on the wing. Gangs of boys, armed with home-made butterfly nets patrol the fields of young ratoon cane and have little difficulty in capturing fifty or seventy-five in a day.

In young cane, where the stalk is not large, the entire shoot is killed by *Castnia*, the larva retreating into the stool and going into another shoot to complete its development. In fields of young cane, the boys going through, cutting out the dead hearts caused by *Diatræa*, are also able at the same time to cut out the shoots injured by *Castnia* and capture the larva inside. Three years ago, and more, when *Castnia* was a much more serious pest than it is now, the price set for the larvæ was one cent each. The amount of money the boys were able to earn by cutting out giant borer larvæ was so great that the insect received the name of "gold-digger." Another opportunity the boys have of collecting the "gold-digger" is after the cane is cut for the mill, when the conspicuous black hole in the stubble of the cane shows where a fully grown larva is hidden in the stool below. Very few larvæ are ever found in the cut stalks, as the larva retreats into the stool when it becomes aware of the approach of the cane cutter. The tunnels are considerably larger in proportion to the size of the insect than are those of the smaller moth borer and the insect can move in them more quickly.

Mr. J. J. Quelch told me of fields where *Castnia* injury had been particularly severe and wholesale methods of destruction had been necessary. After the cane was cut, the field was flooded for several weeks entirely killing out all *Castnia* larvæ and pupæ present in the stools.

Three years ago the injury by the giant moth borer to cane all over Demerara became so severe that strenuous measures had to be adopted. It was at this time that the four control measures above described were tested out and found to be thoroughly practical and satisfactory. They are as follows:

(1) Collecting of the adult moths in butterfly nets.

(2) Cutting out the young larvæ in the young ratoon cane.

(3) Cutting out the older larvæ and pupæ from the stools of cane after the crop has been harvested.

(4) In the case of very heavy infestation, the flooding of the entire field after the cane is cut.

The control thus obtained is not permanent and is maintained only by the persistent enforcement of these regulations, even at times when *Castnia* has become comparatively scarce. No outbreak need

be feared so long as the collection is kept up, and even should *Castnia* become abundant again, there would be no cause for alarm, as the measures of control are well known and their effectiveness has been demonstrated.

When one enters a field where the cane is soon to be cut, his first impression is of the enormous amount of cane that has been seriously injured by *Diatrœa*. This primary injury by *Diatrœa* is sufficiently important in itself, but in addition there is the secondary infestation by other insects that only enter cane that has been previously injured by something else. . . . All stages of the weevil stalk borer, *Metamasius hemipterus* Linn., are to be found in the greatest abundance. If this pest were able to reproduce rapidly and survive adverse conditions, the injury it might produce would be very great, but nowhere was it observed to cause nearly so much injury as *Diatrœa*.

Much cane is also injured by termites, or "wood ants" as they are called by the planters. They never attack sound cane, but as all the cane in Demerara is infested with *Diatrœa*, the termites have no difficulty in finding a place of entrance to the interior of the stalk. They hollow out the stalk so completely that only a thin shell remains, which easily breaks through when grasped in the hand. The termites use the cane stalks as a source of food and building material, and as a living place. They also build many galleried nests, the individual walls of which are thin as cardboard and break through readily, but the nest will not break into large pieces even when subjected to rough treatment. It is a common practice to carry these nests from the field when the cane has been cut, and burn them on the towpaths at the edge of the field. This control measure seems to be quite effective, although the danger of gravid females dropping from the nest while it is being carried across the field, is quite serious. The nests undoubtedly should be carried in a bag or on a tray.

The sugar-cane mealy bug, *Pseudococcus calceolariœ* Mask. was moderately abundant in most fields. As compared with the injury caused by *Diatrœa* and *Castnia*, the mealy bug is not considered a serious pest. Its numbers are kept in check somewhat by a predaceous lady beetle, the name of which has not been determined.

The final impression one carries away with him of the cane insect problem in Demerara concerns chiefly the following points:

(1) The enormous and wide-spread injury by the smaller moth borer, which despite all control measures now being used against it and the natural control by the various parasites, seems to be holding its own and is most decidedly not less abundant than it was at any time in the past.

(2) The serious injury by the giant moth borer, which is being controlled and is much less abundant than formerly, and

(3) The comparative insignificance of the injury by the other minor cane pests, *Metamasius*, termites and the mealy bug, which despite its intrinsic importance, seems almost negligible by comparison with the injury by *Diatræa*.

In Trinidad, the situation in regard to the insect pests of cane is unique. The most injurious pest is not *Diatræa*, as it is in practically all other sugar producing countries of the West Indies, but a froghopper. Insignificant as is the injury produced by froghoppers elsewhere, in Trinidad the froghopper has achieved as much notoriety as a pest of cane as has the boll weevil in the United States. The sugar cane froghopper of Trinidad, *Tomaspis varia* Fabr., is a small bug, that passes its immature stages as a nymph underground feeding on the roots of cane, grass and weeds. The adult is one quarter to one half inch long, with blue-black wings banded with yellow, folded over its back. It sucks juice from the leaves and stalk of cane, but produces no serious injury. The eggs are laid in the trash and sometimes in the ground, from which the newly-hatched larvæ have no difficulty in reaching the roots of the cane. Despite the insignificant size of the nymphs, the enormous numbers in which they appear on the roots of the cane, especially if they chance to be abundant during a dry spell when the cane is young, either kills the cane outright, or so stunts the growth, that the crop is worthless and in many cases the field is abandoned.

It is not at all surprising that *Tomaspis* should be a pest on cane in Trinidad when one considers the agricultural field practices most common there. What an unprejudiced observer first notices is the great abundance of weeds in the fields of cane. Grass and weeds are alternate host plants, if they are not the original hosts of *Tomaspis*, and as they are allowed to grow almost unchecked in the cane fields, it is not surprising that the froghoppers have also attacked the cane. Another most noticeable feature of Trinidad agriculture is the large number of abandoned fields, where a few stools of cane still remain, but are mostly grown up to grass and weeds. The roads and "traces" through the cane estates and the land along the railroads are overgrown with weeds. The whole environment is ideal and could not be better for the propagation of large numbers of froghoppers and other pests of cane. When the managers of the estates come to realize the importance of cleaning up the grass and weeds in the cane fields and of planting some other crop in the abandoned fields, there will be a most noticeable reduction in the injury to cane by insects, and more particularly in the injury caused by the froghopper. Because of the

lack of sanitation in the fields, the froghopper is a difficult pest to control and is rendered all the more difficult because of the lack of vulnerable places in its life history.

The nymphs are found only on the roots of cane, where no insecticide can reach them. The adults are of such small size and are so active, that their collection by boys is impracticable. It might be possible to reduce their numbers by burning the trash in which their eggs are deposited, but as the eggs are also deposited in the ground and it is usually in the moister trash which is closest to the ground and most difficult to burn, that most of the eggs are deposited, this practice would only destroy much-needed humus. and leave the major portion of the eggs undestroyed. As all ordinary methods of control are impracticable, a most novel and unusual plan of campaign has been adopted.

The fungus, *Metarrhizium anisopliæ* Sorokin, produces a fatal disease of froghoppers and other insects called the Green Muscardine. When the fungus spores are widely diffused throughout a cane field, a heavy mortality of the froghoppers follows, if the moisture and temperature conditions are favorable. At the beginning of the rainy season, when the froghoppers begin to become most abundant, the conditions for the growth and development of the fungus are ideal. Although attempts to use fungus diseases in combating insects have been made elsewhere, never before has the growth of large amounts of fungus spores and their thorough distribution throughout a field to kill the insect pests of the crop growing there been attempted on so large a scale. The spores of *Metarrhizium* are grown on layers of cooked rice spread out on trays three feet square, ten of which trays are contained in a culture cabinet. As about 70 pounds of the mixture of spores with the proper amount of cassava starch for field dusting are produced from one cabinet; on several estates in Trinidad as many as four of these cabinets are in operation, and as the length of time for the maximum production of spores is only three weeks, it is apparent that the commercial production of spores has been made practical. The application of spores in the field is made from a blower mounted on a railroad flat car. The pioneer work in the devising of large-scale, commercially practical methods of growth and application of fungus spores has been done by Mr. J. B. Rorer, Pathologist of the Trinidad Board of Agriculture. To his recent article in "Phytopathology," April, 1913, pp. 88–92, one may be referred for the details of the work.

The practical results of this field dusting are somewhat inconclusive, as few of the cabinets were put into operation till towards the end of the rainy season last year, and most of the dusting has been done during the dry season when conditions are not optimum for the pro-

duction of an epidemic of the Green Muscardine disease among froghoppers. Mr. Urich assured me, however, that in the one examination he made where spores had been applied early, at least 95 per cent. of the nymphs in the stool of cane were found dead and covered with the characteristic olive green spore masses of *Metarrhizium.*

Most of the planters seem to be convinced of the desirability of using this fungus for the control of the froghopper, and on most of the estates of the island cabinets for growing the spores were seen. Mr. Connell has already dusted with the spores over 500 acres of cane land at Esperanza estate, and at other larger estates it is planned to dust similar areas. It will be with much interest that the outcome of this most extensive spore dusting during the coming wet season will be watched.

In addition to the work with the Green Muscardine, a diligent search has been made for predators and parasites. In the fall of 1911, Mr. Urich went to Mexico, where *Tomaspis postica* Walker, does considerable injury to cane, and he imported from there a Reduviid bug, *Castolus plagiaticollis,* which is a very efficient predator on the adult froghoppers. . . . From grass collected in the moist valleys and ravines in the northern part of Trinidad, two Chalcidid parasites have been bred by Mr. P. L. Guppy, Mr. Urich's assistant. One of these is a brilliant vermillion color and the other a light brown. Neither has yet been bred in large numbers; and it is doubtful if they will be of economic importance. That they already occur in the island, and in localities not more than a few miles from cane fields heavily infested with froghoppers, indicates that unless some very successful method of artificial propagation is devised they will never be of much practical value, although interesting from a scientific standpoint.

On all cane estates in Trinidad, the injury by *Castnia licus,* the giant moth borer, is most noticeable. Indeed, from what superficial observations I was able to make, it seemed to be more common than in Demerara. Its numbers are becoming less each year in Demerara, but in Trinidad, the pest is rapidly becoming more abundant, as Mr. Urich informed me that on only a few estates were control measures attempted. It is impracticable to flood the fields from which cane has recently been cut, no attempt is made to collect the full-grown larvæ and pupæ from the stools of cane, and the young larvæ are not cut out of young cane, but most energetic measures are used for the collection of adults by gangs of boys with butterfly nets. That this method of control is successful if continued over a series of years, is shown by the figures given below, showing the number of adults collected on one estate.

Castnia Adults Collected on One Estate

Year	1909	1910	1911	1912
No.	182,734	116,707	89,768	52,271

Approximately the same number of boys was employed in the collection each year and the figures are therefore comparable. If the collecting of adults for four years produced a decrease of over 70 per cent. in the numbers of the pest, it may be more easily realized how much better *Castnia* is kept under control in Demerara where additional measures are used.

Although cane infested with the smaller moth borer is common in Trinidad, the injury by this species is not serious as compared with that produced by the froghopper. Although much more common than *Castnia,* the total amount of injury produced by *Diatræa* is not so great. Nothing in the way of control is attempted on any estate. None of the managers have sufficiently realized the loss caused by *Diatræa* to seriously attempt to control it. This is not particularly surprising as the *Diatræa* larvæ are abundant only during the beginning of the rainy season, May and June, but after this they are comparatively scarce. Ordinarily the smaller moth borer does not cause much dead heart, as the larvæ do not become abundant until after the cane has advanced beyond the earlier stages of growth. In that portion of the cane stalk between three inches and a foot from the ground occurs about 90 per cent. of all the injury that one sees on cane brought to the mill. This was especially noticeable at the Usine Ste. Madeleine. Whether any other factors than rainfall and abundance of parasites enter into this sudden appearance and practical disappearance of *Diatræa* has not yet been worked out. The egg parasite *Trichogramma minutum* (*pretiosa*) Riley, is quite common and the brilliantly marked braconid parasites of the larvæ are abundant in the fields. Three of them were seen hovering over the cane on the cane carriers of the Usine. They were not feeding on the juice from the cut ends, but rather were examining the *Diatræa* holes.

Among the more important minor pests of cane in Trinidad are the weevil stalk borer, *Metamasius hemipterus* Linn., var. *decoloratus* Gyllh., the "gru-gru" worm, *Ryncophorus palmarum* Linn., and the sugar-cane mealy bug, *Pseudococcus calceolariæ* Mask. The latter is moderately abundant on most cane, but appears to do but little serious injury. It is attacked by the larva of a predaceous lady beetle, which is present where the mealy bugs are most abundant. The injury by the "gru-gru" worm is mostly confined to seed-cane that has not been properly treated with Bordeaux mixture. The weevil stalk borer is quite common but never so abundant as to do serious damage. In some of the cane brought in to the Orange Grove mill by coolie cane farmers, a few stalks were noticed which had been almost entirely destroyed by termites. While looking over

some of these specimens of its injury in the laboratory, Mr. Urich found a scale insect abundant in the tunnels of the termites.

Although in most respects Barbados is strange and different from Trinidad and Demerara, most of the insect pests are anything but unfamiliar. True, the larger moth borer is not found, nor the froghopper, but the small, stunted, untrashed canes contain an enormous amount of *Diatræa* injury. Both kinds of the sugar-cane mealy bugs, *Pseudococcus calceolariæ* Mask., and *P. sacchari* Ckll., are abundant and with them are almost invariably found the larvæ of a lady beetle. At the time I was there, the sooty mold on the leaves caused by fungous growths on the honey dew secreted by the sugar-cane leafhopper, *Delphax saccharivora* Westw., and the fluffy white masses indicating the position of the egg-masses in the leaves, were most noticeable. The weevil stalk borer, *Metamasius hemipterus* Linn., is also abundant, as thirty larvæ were taken from a single stalk of cane.

With the exception of *Diatræa* all these are minor pests in comparison with the injury produced by the weevil root borer, *Diaprepes abbreviatus* Linn. This is by far the most serious pest here. One can pull up with but slight exertion half-grown stalks of cane, which have been stunted and, in most instances, killed by it. The injury caused by this weevil in Barbados is more serious than that due to *Lachnosterna* grubs in Porto Rico, as the stalks are attacked when only half-grown. Many of the small roots are eaten and the center chewed out of the main tap root of the cane. It is very seldom that the cane plant has sufficient roots left to make any new growth after the grubs have destroyed the tap root, and the plant is then practically dead. When the ground around the stool is dug over, several grubs are found at a depth of one to three feet. When the cane crop is removed from the field, the partly grown grubs do not die, but burrow down to a depth of several feet where they await the planting of the next crop. Mr. Nowell had a grub remain alive for over ten months in a cell of earth in a petri-dish kept in the laboratory, and the grub seemed as healthy and active at the end of that time as when first dug up. . . . No effective method of control is known, but the numbers of the grubs can be considerably reduced by hand picking of the adults. The adult weevils collect in large numbers on corn and sorghum to feed, and there they may be readily captured by boys.

The injury by *Diatræa* in Barbados seems all the more severe because those varieties of cane are grown which have a small stalk and a high percentage of sugar. Although there were probably not so many tunnels in a single stalk as in Demerara, the total amount of injury to the cane seemed to be greater. It was stated that injury by *Diatræa* had been particularly severe this year, but it must be considerable

every year. Mr. Bovell stated that field experiments had shown that cutting out the dead hearts in the young cane caused so much injury by root disease that more sugar was obtained from the untreated cane. The greater part of the injury from *Diatræa* occurs in the upper portion of the stalk and possibly this is another reason why the cutting out of dead hearts was not more successful. *Trichogramma minutum* is the only parasite of *Diatræa* in Barbados.

The most interesting and important insect pest of cane in Barbados from the standpoint of one interested in its parasitism and more particularly the introduction of that parasite into Porto Rico, is the brown hard-back, *Phytalus smithi* Arrow. The genus *Phytalus* is closely related to the genus *Lachnosterna*, the grubs of which genus are so injurious to cane and other plants in southern Porto Rico. The grubs of *Phytalus smithi* never attain to more than half the size of the Porto Rican *Lachnosterna* and they are never sufficiently abundant to cause serious injury to the cane. The reason why they do not become an important pest is probably because they are parasitized by a black wasp, *Tiphia parallela* Smith.

A few years ago in the Island of Mauritius, the cane was attacked by a root grub and in certain parts of the island it caused an entire failure of the cane crop. The adults of this grub were described as new by Mr. Arrow of the British Museum under the name *Phytalus smithi*. A short time later, when Mr. Guy S. Marshall was looking over a collection of local cane pests in Barbados, he noticed beetles similar to the adults of the grub which was such a pest in Mauritius[1] and he decided they were of the same species. It was then remembered that a considerable time ago new cane varieties had been sent from Barbados to Mauritius. The usual method of introduction was to send a few joints of a stalk of cane with the ends sealed and packed in moist sawdust or charcoal, but some varieties had been introduced by sending an entire stool of cane in a pot of soil. It is quite probable that the grubs of *Phytalus smithi* were introduced into Mauritius in the soil surrounding the roots of these new varieties of cane. The parasite *Tiphia parallela* was not introduced with the grubs, and with the parasite not present to check its increase, *Phytalus smithi* became a serious pest. Although most strenuous measures of hand picking the grubs and collecting the adults have been adopted in Mauritius in the hope of entirely exterminating the beetle (for it is a pest in only a comparatively small portion of the island at present), it seemed very desirable to introduce the parasite *Tiphia parallela* to aid in its control. Under the direction of Mr. J. R. Bovell in

[1] Mauritius is a small island in the Indian Ocean, southeast of Africa.

Barbados, a large number of *Tiphia* cocoons are being gathered and these will be sent to Mauritius in cold storage. Spencer's plantation, Christ church, where the cocoons were being dug up, was visited. Mr. A. A. Evelyn, the manager, had five or seven men at work digging to a depth of two and sometimes three feet around the edge of the cane fields, where the grubs of *Phytalus smithi* were most abundant. Judging by the results of my own work in Illinois, they were having only moderate success, as on many days they would discover nothing, although sometimes they would get a dozen or more cocoons in a few hours. As the shipment of cocoons was soon to be despatched to Mauritius, arrangements were made with Mr. Evelyn to continue the work of digging the cocoons of *Tiphia parallela* that some might be sent to Portp Rico and an attempt made to establish the species as a parasite of the smaller species of native *Lachnosterna*.

NOTES ON PODABRUS PRUINOSUS

By H. F. Wilson, *Entomologist, Oregon Agricultural College, Corvallis, Ore.*

During the past two years this insect has been very abundant in the Willamette Valley and is one of the most important agencies in the control of all forms of plant lice.

The three principal species held in check by this pest are the rosy apple aphis (*Aphis sorbi* Kalt?), the black cherry aphis (*Myzus cerasi* Fab.), and the vetch aphis (*Macrosiphum pisi* Kalt?).

The adults begin to appear about the first of May and by June first are very abundant. By July first, only a few individuals can be found. During the warm days along about the first of June the beetles are flying about everywhere, apparently in search of food. They are also quite commonly found in the vetch fields and in the rolls of infested apple and cherry leaves.

They undoubtedly destroy many aphids in a day and are of great economic value. The manner of devouring an individual aphis resembles very much that of a hungry dog with a piece of fresh meat and several companions watching the operation. The aphid is not exactly eaten, as the beetle crushes it with the mandibles and extracts the juices. The remains are then cast to one side and another morsel is sought for.

When disturbed the beetles try to escape from the folds of the leaves and, if resting or crawling on the leaf, will quickly drop to the ground.

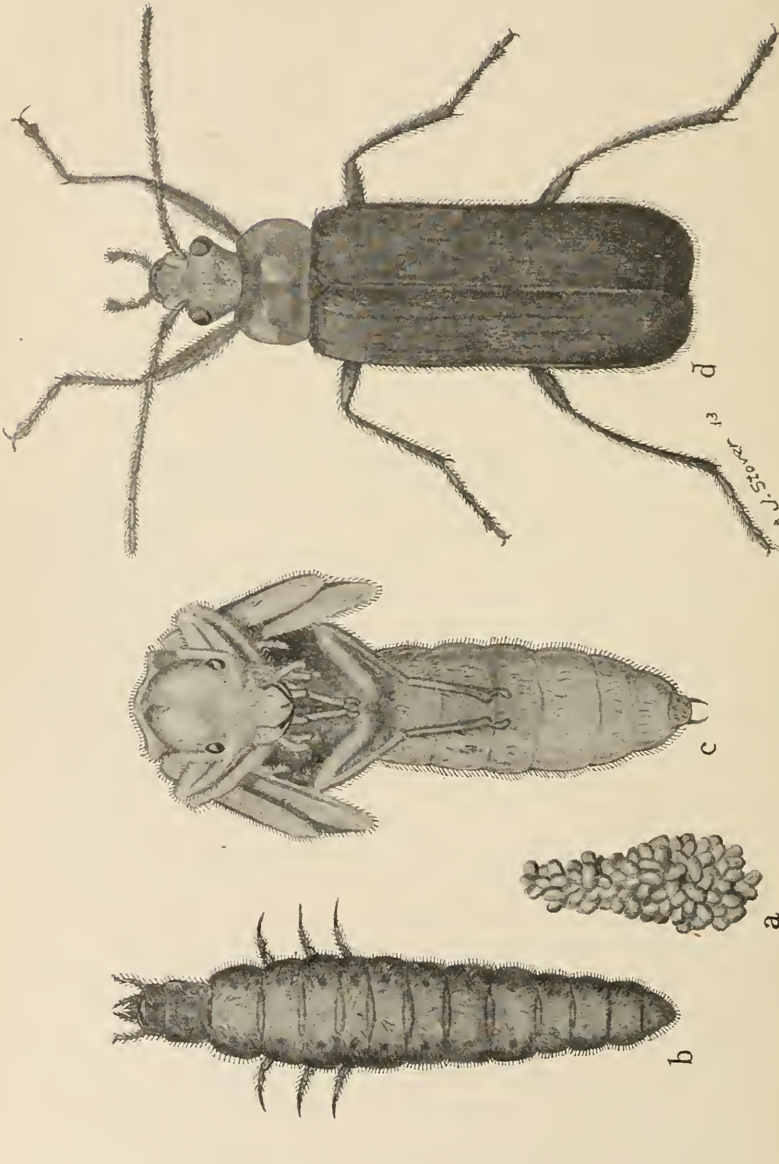

FIGURE 11. *Podabrus pruinosus*; *a*, Mass of Eggs; *b*, Larva; *c*, Pupa; *d*, Adult (Original).

The Various Stages

The *eggs* were not observed in the field but in the insectary they were deposited on top of the ground in masses as shown in figure 11 *a*.

The individual egg is light yellow in color, oblong in shape and measures .36 mm. in length.

The *larvæ* (Fig. 11 *b*) are found in the ground from three to six inches below the surface and when mature measure from 15 mm. to 20 mm. in length. They are pink in color and are covered with numerous fine hairs which give them a velvety appearance. The three thoracic segments have two longitudinal dark markings on the dorsum.

The *pupæ* (Fig. 11 *c*) are found in earthen cells in the moist earth. When the pupal stage is first formed they are white; later they change to pink and as the elytra and appendages develop, they change to a dark blue; the eyes are red; abdomen above and below covered with numerous fine hairs that give them a velvety appearance. Dorsum of prothorax also covered with these hairs. The prothorax above square and shaped as in the adult.

The *adults* (Fig. 11 *d*) are dark blue in color with the prothorax, front part of the head and tip of abdomen light brown. First three segments of the antennæ brownish, shaded with black. Segments following, black with a small amount of brown at the base. Legs black, shaded with brown.

Upper and lower side of abdomen covered with fine light gray hairs. Length of body 10 to 14 mm.

THE GEOGRAPHICAL DISTRIBUTION OF THE STABLE FLY, STOMOXYS CALCITRANS[1]

By Charles T. Brues

The common stable fly, *Stomoxys calcitrans* L., has recently received considerable attention at the hands of entomologists, medical men and veterinarians. It is a nearly cosmopolitan phlebotomic Muscid that has long been a serious pest of domesticated animals and an occasional nuisance to human beings on account of its blood sucking habits. For some time it has been known to act as an occasional carrier for the bacillus of anthrax. More recently it has been shown to be capable of acting as a vector for the virus of acute epidemic

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 69.

poliomyelitis (infantile paralysis) [1] and it is also quite probably a regular or accidental carrier of other human and animal diseases with which its connection has not yet been elucidated.

On account of its importance as an economic insect, it has seemed worth while to publish the following resumé of the distribution of *Stomoxys calcitrans* in different parts of the world. The material here presented has been gathered from many sources; much has been collected from published writings, but a great part has been supplied by entomologists in various parts of the world to whom requests for information were sent. As is evident from the context, the writer is greatly indebted to these gentlemen who have so freely given data from their personal experience.

Next to the common house fly, latterly termed the typhoid fly, this species is one of the most widely diffused species of insects, and has been found in some part of nearly every habitable region of the globe. Like the house fly, it is probably a native of the Old World, most likely of central Europe, and if not actually native to North America, it was evidently brought hither on ships at an early date.

The species was named *Conops calcitrans* by Linnæus in the tenth edition of his Systema Naturæ (p. 604; 2) and soon afterwards Geoffroy [2] erected the genus *Stomoxys* to include this species which was the only one then known. I have not been able to approximate the date of its introduction into America, but its abundance in Philadelphia as early as 1776 is attested by the following excerpt from an account written by Thomas Jefferson.[3] In describing the reasons for the hasty adoption of the American Declaration of Independence by the Continental Congress on July 4th, 1776, Jefferson writes:

"The weather was oppressively warm, and the room occupied by the deputies was hard by a stable, whence the hungry flies swarmed thick and fierce, alighting on their legs and biting hard through their thin silk stockings. Treason was preferable to discomfort."

No entomologist, after reading this paragraph, can question the fact that the "hungry flies" were anything but *Stomoxys calcitrans*, so characteristic is Jefferson's account.

That it was present in the United States in the early colonial days is thus certain. One should expect as much, however, for it is adapted

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[1] Brues, C. T. The Relation of the Stable Fly (*Stomoxys calcitrans*) to the Transmission of Infantile Paralysis. Journ. Econ. Entom., Vol. 6, pp. 101–109 (April, 1913).

[2] Histoire Abregée des Insectes, II, 538 (1762, 1764, 1799).

[3] For this interesting information I am indebted to an article by Hubert Bruce Fuller, entitled "Myths of American History," which appeared in Munsey's Magazine for May, 1913.

to maintain its existence for long periods on shipboard, and is undoubtedly thus carried for long distances. From the following data recently given me in a letter by Dr. H. H. P. Severin, it will be seen that at the present time the species is readily transported by ships, and conditions in the past must have been still more favorable for its existence under such circumstances. Dr. Severin writes: "In making the trip from San Francisco to Honolulu, the boat on which I was traveling carried about fifteen mules and horses which were placed in temporary stalls on the lower deck of the steamer. These stalls were crudely constructed, consisting of but little more than the roof, and yet during the seven days of the trip, I noticed stable flies pestering these animals."[1] Such adaptability on the part of *Stomoxys calcitrans* undoubtedly accounts for the ease with which it has become disseminated so widely, and it seems strange that other members of the same genus have not followed it generally in its migrations.

Together with a number of related genera, all of old-world origin, *Stomoxys* is usually regarded as forming the subfamily *Stomoxydinæ* of the family Muscidæ. All of these genera are sharply differentiated from other Muscidæ by the piercing mouthparts and phlebotomic habits of the imago. At the present time, some seven genera have been recognized.

1. *Glossina* Wiedemann.
2. *Lyperosia* Rondani.
3. *Hæmatobosca* Bezzi.
4. *Hæmatobia* Robineau-Desvoidy-*Siphona* Meigen?).
5. *Stygeromyia* Austen.
6. *Stomoxys* Geoffroy.
7. *Philæmatomyia* Austen.
8. *Glossinella* Grünberg.

Of *Stomoxys* a large number of species have been described, some thirty-one of which appear to be well founded. Thirteen of these were listed by Bezzi[2] in 1907, and the remainder have since been distinguished.

1. *bengalensis* Picard. Bull. Soc. Ent. France. 20: p. 21 (1908). India.
2. *bilineata* Grünberg. Zoöl. Anz. 30: p. 89 (1906). East Africa.
3. *boneti* Roubaud. Bull. Soc. Path. Exot. 4: p. 124 (1911). Dahomey.
4. *bouffardi* Picard. Bull. Soc. Ent. France, 1907, p. 27. Sudan.

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[1] Since Dr. Severin's communication was received, the writer has had the opportunity to observe the same conditions on steamers that carry horses and cattle, plying on the western coast of South America between ports in Panama, Ecuador and Peru.

[2] Mosche Ematofaghe. Rendi. R. Ist. Lomb. Sci. and Lett., II: 40 (1907).

5. *brunnipes* Grünberg *ibid.*, l. c. Camerun; Eritrea.
6. *calcitrans* Linné Syst. Nat. 10; 604. 2 (1758). Distribution discussed below.
7. *dacnusa* Speiser. Zoöl. Anz. 33: p. 667 (1908). Annam.
8. *glauca* Grünberg *ibid.*, 30: p. 88 (1906). Camerun; Togo.
9. *grisciceps* Becker. Mitt. Zoöl. Mus. Berlin, 4: p. 195 (1908). Madeira.
10. *hovas* Brauer. SB. Akad. Wien, 108: p. 517 (1899). Madagascar.
11. *indica* Picard. Bull. Soc. Ent. France, 20: p. 20 (1908). India.
12. *inornata* Grünberg. Zoöl. Anz. 30: p. 90 (1906). Camerun.
13. *lafouti* Picard. Bull. Soc. Ent. France, 1907, p. 28. Mauritius.
14. *libatrix* Robineau-Desvoidy. Myod. p. 387 (1830). Southeastern India.
15. *limbata* Austen. Ann. Mag. Nat. Hist. (8) 3: p. 292 (1909). India.
16. *nebulosa* Fabricius. Syst. Antl. p. 282 (1805). (*calcitrans* Linn.?). South America.
17. *nigra* Macquart. Mem. Soc. Sci. Lille, 1850, p. 212. Natal; Mauritius.
18. *oblongopunctata* Brunetti. Rec. Indian Mus. 4: p. 73 (1910). India.
19. *ochrosoma* Speiser. Sjöstedt's Kilimandjaro-Meru Exped. 10–5: p. 162 (1910). German East Africa.
20. *omega* Newstead. Ann. Trop. Med. & Paras. 1: p. 87 (1907). West Africa.
21. *pallida* Roubaud. Bull. Soc. Path. Exot. 4: p. 125 (1911).
22. *plurinotata* Bigot. Bull. Soc. Zoöl. France, 12: p. 593 (1887). Ceylon.
23. *pratti* Summers. Ann. Mag. Nat. Hist. 8: p. 238 (1911). Straits Settlements.
24. *pulla* Austen. Ann. Mag. Nat. Hist. (8) 3: p. 294 (1909). India.
25. *pusilla* Austen *ibid.*, t. c.: p. 293 (1909). India.
26. *sellata* Grünberg. Zoöl. Anz. 30 : p. 90 (1906). Kamerun.
27. *sexvittata* Roubaud. Bull. Soc. Path. Exot. 4: p. 396 (1911). Sudan.
28. *sitiens* Rondani. Ann. Mus. Civ. Genoa, 4: p. 288 (1873). Eastern Africa.
29. *tæniata* Bigot. Bull. Soc. Zoöl. France, 12: p. 594 (1887). Port Natal.
30. *triangularis* Brunetti. Rec. Indian Mus., 4: p. 77 (1910). India.
31. *varipes* Bezzi. Rendic. Ist. Lomb. (2) 40: p. 446 (1907). Eritraea.

The following citations of localities for *Stomoxys calcitrans* is undoubtedly by no means complete, particularly since this species has been incidentally referred to a great many times in the literature of economic entomology and also frequently in miscellaneous publications of various kinds. Even in the United States where it probably occurs commonly in every state, published records are scanty and many of the localities here cited have been kindly furnished by entomologists from their personal experience. In the same way a number of foreign entomologists have supplied similar data, and to all I am greatly indebted for their uniformly courteous attention to my requests for information.

United States of America

Arizona.—Mr. F. C. Bishop has recently written me that he heard through Dr. Morrill of Phoenix, Ariz., that the stable fly is, so far as he has observed, rather rare in that state. Dr. Morrill has seen the species resting in considerable numbers on his house in Phoenix, but never noticed them in abundance around dairies.

California.—Mr. C. H. Richardson, Jr. informs me that the stable

fly is very common in southern California where it is a serious pest to cattle, and Professor Doane writes that he has found the larvæ breeding very commonly in cow manure around dairy barns in the vicinity of Stanford University. Herms [1] mentions it as a household insect in California.

Colorado.—Bishopp [2] quotes from Prof. Gillette the statement that this species is possibly the worst pest of livestock in Colorado on account of its being so abundant and ever present.

Professor Cockerell writes that it is abundant at Boulder, Colo. and that one of his students, Mr. Tucker, found it at Tabernash.

District of Columbia.—Howard [3] who has studied this insect rather extensively in Washington, D. C., refers to its abundance there in late summer.

Connecticut.—The stable fly is widely distributed throughout Connecticut, apparently in about the same abundance as has been observed in Massachusetts. The writer has seen it especially abundant along the Connecticut Valley in late summer.

Florida.—The writer has seen the stable fly in the northeastern part of Florida, but it does not appear to be nearly so common there as in the northern states. Johnson [4] records it from St. Augustine and Lake Worth, and Bishopp [5] states that investigations made in Central Florida indicate that it is seldom of importance as a pest in that section.

Georgia.—According to Bishopp [6] the stable fly is a pest of more or less importance in the grain belt of this state every year.

Mr. C. W. Johnson also informs me that he has specimens in his collection, collected by Pilate at Tifton, Ga.

Illinois.—The stable fly is abundant about Chicago and many parts of northern Illinois, according to the experience of the writer.

Prof. A. D. MacGillivray, in a letter, has offered the following note concerning its occurrence in the northern central portion of the state near Urbana: "In the two years that I have been here, this insect has been quite abundant. The flies come into the laboratory and bite us on the shins so as to almost drive us out in the afternoons. Last September there was a great reduction in the amount of milk produced in this region, and the dairies all reported a great abundance of flies, which of course meant the stable fly."

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1 Bull. Agric. Expt. Sta., California, No. 215, p. 517 (1911).

2 Journ. Econ. Entom., Vol. 6, p. 115 (1913).

3 Proc. Washington Acad. Sci., II, p. 578–579 (1900).

4 Proc. Acad. Nat. Sci., Philadelphia, p. 335 (1895.)

5 Journ. Econ. Entom., Vol. 6, p. 115 (1913).

6 Journ. Econ. Entom., Vol. 6, p. 115 (1913).

Prof. H. A. Surface also writes that he has seen this insect abundant in Illinois.

Iowa.—Prof. H. F. Wickham writes: "About the distribution of *Stomoxys calcitrans*, I have no formal notes, but it is very common here, though perhaps less so than during my boyhood when little care was taken in the disposition of refuse."

Prof. O. A. Johannsen has also observed it personally at State Center, Iowa.

Kansas.—Bishopp [1] refers to this species as a pest of more or less importance every year in the grain belt of this state.

Kentucky.—Garman [2] speaks of *Stomoxys calcitrans* as extremely abundant at St. Vincent, Ky., during August, 1895, and observed the flies very commonly at Lexington, Ky., as late as October 20, 1890, sunning themselves in great numbers on the sides of buildings.

Maine.—Prof. O. A. Johannsen writes that the stable fly occurs at Orono. Me., where he has observed it personally.

Maryland.—Mr. S. N. Cory has kindly furnished the following notes on the occurrence of the stable fly in Maryland: "It is abundant in this state where we have bred it from horse- and hog-manure. In 1908 it was the species most abundantly bred out in the insectary from this material collected late in the fall.

Massachusetts.—Extensive observations, particularly in the eastern portion of the state have revealed an abundance and seasonal distribution similar to that which exists in most of our other northern states. The adults do not appear in noticeable numbers until the early part of June. They are then to be seen very generally in localities where there are many domestic animals, but not in sufficient numbers to annoy cattle or horses to any extent. At this time also they are much more local in occurrence, for they do not appear to wander far from barns, stables and pastured animals. In another month they have increased greatly in numbers and begin to appear quite generally in places quite removed from such animals, while horses and cattle are considerably annoyed by them. During August there is a still greater increase in their numbers, and it is during this month that animals are most severely bitten by them. At this time they can be seen in abundance almost anywhere, although as before they are most numerous in places where they can find large animals upon which to feed. During September they are scarcely less abundant, until the latter part of the month when they become much less active and are to be seen almost entirely on fences and walls,

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[1] Journ. Econ. Entom., Vol. 6, p. 115 (1913).

[2] Ann. Rept. Kentucky Agric. Expt. Sta. (8th) for 1895, p. 1 (1896).

particularly if these are constructed of wood and painted. Even in the summer they are attracted to such warm surfaces in the full glare of the sun except during the middle of the hottest days; they then migrate to places illuminated by more slanting sunshine. In this way during a single day they will successively congregate upon such portions of a barn as present the desired warmth and sunshine. By October the activity of the flies is much diminished, and on cool mornings they remain in a dormant condition. However, as soon as the air becomes warmer, later in the day, they again become active, and at this time of the year almost replace the house fly which has decreased greatly in numbers. Even after a severe frost, they do not disappear entirely if the weather again becomes warm. In warmed stables they persist in greatly decreased numbers throughout the winter in a semi-active state, and stable-men recall having been bitten by them when sitting about heated stable stoves in the dead of winter.

There are a number of published references to the occurrence of the stable fly in Massachusetts, but they do not add materially to the above statement. It is interesting to note, however, that Harris [1] as early as 1842 speaks of cattle and horses being much tormented by the bites of these insects.

Michigan.—Prof. R. H. Pettit informs me in a letter that the stable fly is common throughout southern Michigan and that he has seen them extremely abundant in the northern part of the state a short distance from Mackinaw.

Minnesota.—Washburn [2] in his Diptera of Minnesota says that the stable fly is found in large numbers about stables in Minnesota.

Professor Washburn has also been so good as to inform me by letter that his observations would indicate that the species is quite common in the neighborhood of all the towns over the state.

Missouri.—Mr. Leonard Haseman writes from Columbia, Mo., that he has never seen the stable fly so abundant in any part of the United States where he has been, as it is in Missouri. He says that it is a great scourge of live stock and aside from the house fly and the horn fly, the most abundant fly breeding in horse-manure in the region about Columbia.

Mississippi.—Bishopp [3] states that the stable fly occurs commonly in Mississippi and sometimes becomes a considerable pest of live stock.

Montana.—Mr. William M. Mann tells me that the stable fly is a common insect in Montana.

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[1] Insects Injurious to Vegetation, p. 412.

[2] Tenth Ann. Rept. Entom. Minnesota, p. 148 (1905—).

[3] Journ. Econ. Entom., Vol. 6, p. 115 (1913).

Nebraska.—Bishopp [1] refers to this species as a pest of more or less importance every year in the grain belt of this state.

New Hampshire.—Prof. W. C. O'Kane writes that he has specimens of the stable fly from Pelham, N. H., but that the species has not been reported by correspondents throughout the state during recent years.

The writer found the species very abundant at Wilton, N. H., on a visit there during the summer of 1911.

New Jersey.—Howard [2] quotes Dr. John B. Smith as having mentioned the abundance of this species in his house in New Brunswick, where he had noticed their increase in numbers during the late summer and fall, till by November 1st they had almost replaced the house fly at that place.

In his Insects of New Jersey it is referred to as "common throughout the state; a great pest of cattle" (Edit. 1890, p. 392; *id.* 1900, p. 679; *ibid.* 1910, p. 788).

New Mexico.—Prof. T. D. A. Cockerell writes that he found the stable fly abundant at Las Vegas, N. M., in 1900–01, and that he found it also at Pecos on the upper Pecos River and at Roswell.

New York.—As early as 1849 Fitch [3] speaks of the stable fly as most tormenting, especially to horses in New York state.

Prof. O. A. Johannsen writes that he has observed it at Ithaca, N. Y., and the writer has observed it commonly in the environs of New York city. Felt also records it [4] from New York without specific localities saying "that it may be rather abundant about houses in the fall."

Ohio.—Prof. J. S. Hine writes that he has observed this species in every part of Ohio in which he has been and Prof. H. A. Surface has seen it "abundant in the southeastern part of Ohio."

North Carolina.—Mr. Z. P. Metcalf writes that he has specimens of the stable fly from Raleigh, Beaufort and Southern Pines, and that he is sure of having observed it in other parts of the state as well.

Oregon.—Howard [5] mentions the appearance of extraordinary numbers of the stable fly near Salem, Ore., in 1888, and Prof. J. M. Aldrich writes me that he has this species in his collection from Corvallis, Ore.

Pennsylvania.—Prof. H. A. Surface writes that the stable fly is generally distributed throughout Pennsylvania, and says that he is

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[1] Journ. Econ. Entom., Vol. 6, p. 115 (1913).

[2] The House Fly—Disease Carrier, p. 241 (1911).

[3] Trans. N. Y. State Agric. Soc., Vol. IX, p. 803.

[4] Bull. New York State Mus., No. 136, p. 7 (1910).

[5] The House Fly—Disease Carrier, p. 244 (1911).

not aware that there is any part of the state in which it does not occur.

Rhode Island.—Mr. C. W. Johnson has specimens from Kingston, R. I., and the species is evidently equally abundant in Rhode Island as in the adjoining states.

South Carolina.—Bishopp [1] states that the stable fly occurs commonly in South Carolina and sometimes becomes a considerable pest of live stock.

South Dakota.—According to Bishopp [1] statements by farmers in South Dakota indicate that the stable fly is sufficiently abundant there to become a live-stock pest.

Prof. J. M. Aldrich writes that he has specimens in his collection from Brookings and Custer, S. D., and that he has observed it as troublesome to horses in South Dakota.

Texas.—Very recently Bishopp [2] has referred to the great abundance of the stable fly in northern Texas during the summer of 1912 and to its prevalence in the same region every year. In the south central portion of the state, the present writer found the species always rather commonly, but not in excessive outbreaks during several years of residence there. It is undoubtedly very widely distributed in Texas and an extremely important pest of live stock in most if not all parts of the state.

Bishopp (l. c.) also says that this species was reported as extremely abundant in north central Texas as early as 1867, and that later outbreaks occurred in 1894 or 1895 and in 1905.

Pratt [3] records the species as very abundant in and about stables at Dallas, Tex., but as not breeding commonly in cow-manure according to his observations.

Virginia.—Howard [4] has found this species commonly in northern Virginia, and mentions its occurrence in out-of-door privies in this region.

West Virginia.—Howard [5] refers to the occurrence of adult stable flies in out-of-door privies at Charleston, W. Va.

Wisconsin.—Carlyle [6] records *Stomoxys calcitrans* as being very common and as constantly worrying stock, particularly cattle in the "Northwest." The writer has observed it in numbers in southeastern

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[1] Journ. Econ. Entom., Vol. 6, p. 115 (1913).

[2] Journ. Econ. Entom., Vol. 6, p. 112–126 (1913).

[3] Canadian Entom., Vol. 44, p. 182.

[4] Proc. Washington Acad. Sci., II, p. 579 (1900).

[5] Proc. Washington Acad. Sci., II, p. 579 (1900)

[6] Ann. Rept. Wisconsin Agric. Expt. Sta. for 1889 (16th), p. 92 (1899).

Wisconsin, near Milwaukee, as well as in the more northern parts of the state.

Canada

Hutt [1] speaks of *Stomoxys calcitrans* as commonly found in houses in Ontario, and it is undoubtedly well distributed in at least the more southern parts of Canada.

Alaska

Mr. A. B. Parks who has collected insects extensively in Alaska writes that *Stomoxys calcitrans* occurs in Sitka and that he has seen it also at Skagway, 500 miles further north. At Sitka it was abundant around barns during July and August.

Bermuda

Mr. C. W. Johnson has kindly furnished me with a record of the occurrence of the stable fly in Bermuda, based on a specimen in his collection bearing the date of January 20.

Bahama Islands

Mr. C. W. Johnson has given me a record of the stable fly in the Bahamas, based on material in his collection and he has also made a published reference [2] to specimens taken at Nassau.

West Indian Islands

Porto Rico.—Coquillett [3] has recorded a single specimen from Vieques Island, contained in a small collection of Diptera made in Porto Rico.

Cuba.—Prof. J. M. Aldrich tells me that he has a specimen in his collection from Havana, Cuba.

Jamaica.—The writer has had the opportunity personally to observe the occurrence of this species in Jamaica. It seems nowhere to be so abundant as in temperate North America and is restricted mainly to the regions near sea level. I have never noticed it on mules or donkeys when traveling at altitudes of over two or three thousand feet.

There is also a published record by Newstead.[4]

Hayti.—Mr. William M. Mann, who has collected on this little-

[1] Rept. Entom. Soc. Ontario, No. 29, p. 100 (1898).

[2] Psyche, Vol. 15, p. 77 (1908).

[3] Proc. U. S. Nat. Mus., Vol. XXII, p. 256 (1900).

[4] Rept. 21st Exped. Liverpool, Sch. Trop. Med., Jamaica (1908–09), and Bull. Jamaica Dept. Agric., N. S., Vol. 1 (1910).

known island, informs me that he has commonly noticed stable flies biting his horse in various parts of Hayti.

St. Vincent.—Williston[1] has included *Stomoxys calcitrans* in his Diptera of St. Vincent.

Grenada.—The writer has seen the stable fly in Grenada, but at least during August and September it is not so numerous as to be a noticeable pest to domestic animals.

Mexico.—Van der Wulp[2] cites Tabasco, Orizaba and Mexico City as localities and Mr. W. M. Mann has recently observed it in the State of Hidalgo at an altitude of 9000 feet.

Costa Rica.—Van der Wulp[3] has recorded *Stomoxys calcitrans* from two localities, Caché and Rio Sucio.

Central America

Panama.—The writer has observed the stable fly in the Canal Zone during May, but in very small numbers. It does not appear to be an abundant insect in Panama.

South America

Colombia.—This species occurs at least in the coastal region of Colombia, near Buenaventura, where I have seen it, although in very small numbers.

Ecuador.—In the city of Guayaquil, Ecuador, and in its environs the stable fly was to be found occasionally during May and June, at the onset of the dry season, but not in noticeable numbers. Most of the specimens which I collected there are much smaller than those from more temperate regions.

Peru.—Prof. C. H. T. Townsend, an eminent authority on Muscoid flies, who has resided in Peru for a number of years, has been so good as to furnish information concerning the occurrence of the stable fly in that country. He writes: "I can say that *Stomoxys calcitrans* occurs throughout Peru below certain altitudes, which I would estimate at six or eight thousand feet and perhaps higher. It occurs throughout the coast region and I have universally noted it as very troublesome to my mules on trips in the montanya on the eastern side of the Andes, below six or seven thousand feet. . . . I have little doubt that it is distributed all over South America wherever suitable breeding conditions exist.

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[1] Trans. Ent. Soc. London, 1896, p. 366.

[2] Biol. Cent. Amer. Dipt., vol. 2, p. 292 (1896).

[3] Biol. Cent. Amer. Dipt., Vol. 2, p. 292 (1896).

Since receiving this information I have been able to confirm these statements concerning its altitudinal distribution on the western slope of the Peruvian Andes. At Callao and Lima this insect was very abundant during June and July, 1913 (the beginning of the winter), and at San Bartolomé with an altitude of somewhat over 4,000 feet it was still common. At Matucana, however, which is about 7,300 feet above sea-level, I did not observe it.

Chile.—Cited by Reed[1] in his catalogue of Chilian Diptera.

Argentina.—The stable fly is an extremely common insect in many parts of Argentine and an extremely serious pest of cattle in many parts of that country. Dr. Juan Brethes of Buenos Ayres tells me that it attains at least the parallel of 35° south latitude and may perhaps extend further south, although he has no positive data in regard to this. They appear most abundantly in the fall (March and April) and at times in almost incredible numbers. Such a case has been described by Iches,[2] when, in 1908, the Province of Santa Fé was visited by a plague of these insects. In this case their unusual abundance was traced to large amounts of fermenting vegetable débris left after the threshing of wheat and flax.

Brazil.—Austen[3] has found specimens from the lower Amazon region in the collections of the British Museum, and many years ago Desvoidy[4] described *S. sugillatrix* (a synonym of *S. calcitrans*) from Brazil.

Great Britain

Hewitt, who has observed this insect extensively in England speaks[5] of it as being common, especially in the country from July to October, during which time it is frequently seen in houses. He also found it as early in the season as March and April upon the windows of a country house.

Newstead has also referred to its abundance in parts of England, particularly in Liverpool and Chester, where he found the adults resting on shop-fronts in the main city streets.

It is evidently very abundant and generally distributed in England, much as in our own country.

Europe

Stomoxys calcitrans was originally described by Linnæus from Swedish specimens and has since been recorded from practically all

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[1] Cat. Ins. Dipt. Chile. Ann. Univ. Chile, Vol. 73, p. 644 (1888).

[2] Bull. Soc. Nat. Acclim. France, Vol. 56, p. 104–11 (1909).

[3] African Blood-sucking Flies, p. 143, London (1909).

[4] Myodaires, p. 386.

[5] Quart. Journ. Micr. Sci., Vol. 54, p. 356 (1909).

parts of Europe by various writers. Any attempt to enumerate these would occupy so much space that they have been omitted. To judge from published reports, the species appears to reach its greatest abundance in middle Europe, particularly in Germany and Belgium.

Russia.—Portchinsky[1] in an extended paper on the bionomics of *Stomoxys calcitrans* mentions its abundance in Russia. His remarks refer especially to the southern part, but seem to be applied very generally to the country as a whole.

Africa

Algeria.—Recorded by Bezzi [2] from "Algeria" without further notes.

The species is evidently not abundant, at least in certain parts of Algeria and Tunis, as it is not included in Becker's [3] list of Diptera taken by him in this region during the spring of 1906.

Abyssinia.—Drake-Brockman [4] records a number of interesting observations on the occurrence of *Stomoxys calcitrans* in eastern and southeastern Abyssinia. He found the species very common in the Hawash Valley and around Mount Fantali, "where they attack camels, horses, mules, cattle and human beings with equal vigour." It was also present over the great Arussi Plateau and in the region about the River Wabi between Seru Abbas and Mount Abuna. At Ginir, the great trading center for eastern Abyssinia, it was very abundant and troublesome, and also in Borana, a great cattle country northwest of Banissa.

Sudan.—Bezzi [5] lists this species from Asmara-Keren in Sudan, near Khartoum, and Austen[6] records it from Khartoum and Somaliland. Picard[7] cites Bamako in French Sudan, and Roubaud[8] the Nigerian Sudan.

British East Africa.—Austen[9] records *Stomoxys calcitrans* from the East African Protectorate on the basis of specimens in the British

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[1] Mem. Bur. Entom. Cent. Bd. Land Administration & Agric. St. Petersburg, Vol. 8 (1910).

[2] Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).

[3] Zeit. Hym. u. Dipt., Vol. 5, p. 372 (1907).

[4] Bull. Entom. Research, Vol. 1, p. 55 (1910).

[5] Bull. Soc. Ent. Ital. XXXIX, p. 105 (1907).

[6] African Blood-sucking Flies, p. 143, London (1909).

[7] Bull. Soc. Ent. France, p. 312 (1907).

[8] C. R. Acad. Sci. Paris, Vol. 152, p. 1347 (1910).

[9] African Blood-sucking Flies, p. 144, London (1909).

Museum. Duke[1] mentions its presence in Uganda, and also cites Austen.[2]

German East Africa.—Stuhlmann[3] in a paper on the Tsetse fly and the surra disease mentions the occurrence of *S. calcitrans* in certain parts of German East Africa, and Austen[4] states that it is apparently very common there. Grünberg[5] also records it as common.

Zanzibar Protectorate.—Austen[6] has recorded it from Zanzibar.

Lourenço Marquez.—Bezzi[7] lists this species from Delagoa and has more recently[8] referred to a number of specimens obtained in Lourenco Marquez by C. W. Howard, and Austen[9] states that there are also specimens in the British Museum, collected by McMillan who found it to be common everywhere.

Austen has cited (loc. cit.) specimens from this region in the British Museum.

Stomoxys calcitrans has been taken in Natal, as recorded by Austen (loc. cit.).

Austen records specimens from Pretoria (loc. cit.).

Cape Colony.—Bezzi[10] refers to "Capo" as an African locality for the occurrence of this species.

Rhodesia.—In connection with a report on trypanosomiasis in northwestern Rhodesia, Montgomery and Kinghorn[11] record the presence of *Stomoxys calcitrans* in this region.

Neave,[12] in a list of insects taken in the Luangwa Valley in northeastern Rhodesia, mentions taking two or more species of *Stomoxys*, and adds that the genus is relatively scarce and local in the Luangwa Valley, compared with the high ground on either side.

Portuguese West Africa.—Bezzi[13] records Egitto in Portuguese West Africa, 12° south latitude.

Angola.—According to Austen (loc. cit.) specimens have been taken by Wellman in abundance in parts of Angola.

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1 Rept. Sleeping Sickness Comm. Roy. Soc. London, No. 13, p. 89 (1913).

2 Loc. cit.

3 Ber. Land. u. Forstw. Deutsch-Ostafrika, Vol. 1, pp. 137–153 (1902).

4 African Blood-sucking Flies, p. 144, London (1909).

5 Zoöl. Anz., Vol. 30, p. 87 (1906).

6 African Blood-sucking Flies, p. 144, London (1909).

7 Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).

8 Bull. Lab. Zoöl. Gen. & Agrar. R. Scuola sup. Agric. Portici VI, p. 98 (1911).

9 African Blood-sucking Flies, p. 144, London (1909).

10 Bull. Soc. Ent. Ital. XXIX, p. 92 (1907).

11 A Report on Trypanosomiasis of Domestic Stock in Northwestern Rhodesia, Ann. Trop. Med. & Par. Vol. 2, pp. 97–132 (1908).

12 Bull. Entom. Research, Vol. 1, p. 313 (1911).

13 Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).

Congo Free State.—Austen cites its occurrence in Congo Free State where it is very common according to Todd[1].

Northern Nigeria.—One locality, Keffi, in the Province of Nassarawa is given by Austen.[2]

Gold Coast.—Various localities on the Gold Coast are cited for *Stomoxys calcitrans* by Austen (loc. cit.) on the basis of specimens in the British Museum.

Ivory Coast.—Picard[3] has seen specimens from the Ivory Coast.

Guinea.—In Guinea, Bezzi [4] records Togo as a locality, in latitude 8° south, longitude 0°, and Grünberg[5] also cites "Togo."

Gambia.—Bezzi [6] records the species as occurring in Gambia on the West Coast of Africa, latitude 14° north, and Austen[7] mentions a number of Gambian localities, based on specimens in the British Museum. Todd[8] also found it abundantly in this region.

Canary Islands

The species is recorded by Bezzi [9] from the Canary Islands without further remarks, and many years ago Macquart included it in his list of Diptera of these Islands.[10]

Quite recently Becker has referred to it,[11] but apparently only on the basis of Macquart's publication.

Madeira Islands

Becker lists this species in his enumeration of the Diptera of the Madeira Islands [12] and Prof. T. D. A. Cockerell writes that he is positive that he found it common at Furchal, Madeira, in 1879, though he does not find any reference to it in his diary of that year.

Azores.—Austen states that there are specimens in the British Museum from the Azores (loc. cit.)

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1 Ann. Trop. Med. & Paras., Vol. 1, p. 76 (1907).
2 African Blood-sucking Flies, p. 143, London (1909).
3 Bull. Soc. Ent. France, p. 312 (1907).
4 Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).
5 Zoöl. Anz., Vol. 30, p. 87 (1906).
6 Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).
7 African Blood-sucking Flies, p. 143. London (1909).
8 Ann. Trop. Med. & Paras., Vol. 1, p. 76 (1907).
9 Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).
10 Hist. Nat. Iles. Canar. 114, 70 (1839).
11 Mitth. Zoöl. Mus. Berlin, IV, p. 111 (1908).
12 Mitth. Zoöl. Mus. Berlin, IV, p. 195 (1908).

Mauritius

According to Bezzi [1] the species occurs in this island as he gives the reference "Isola di Francia" without further remarks.

Asia

Seychelles Islands.—Recorded by Austen (loc. cit.) from specimens in the British Museum.

Persia.—Becker and Stein[2] record the occurrence of *Stomoxys calcitrans* in the Province of Baluchistan, Persia.

Palestine.—Recorded by Austen (loc. cit.) on the basis of specimens in the British Museum.

India.—F. W. Howlett, the Imperial Pathological Entomologist of the Agricultural Research Institute at Pusa in Bengal, India, has been so kind as to furnish the notes which follow, concerning the occurrence of the stable fly in India.

"*Stomoxys calcitrans* may, I think, be said to be common all over India. I have myself taken it at the following places: Pusa, Calcutta, Lebong (near Darjeeling and about 4,500 feet elevation), Allahabad, Simla (7,000 feet), near Mussoorie (at about 5,000 feet), Lahore, Bombay, Parel and Bassein (both near Bombay), Poona, Coonoor (near Ootacamund, a hill-station in the Nilgiri Hills), Coimbatore (at the foot of the same hills), and Madras.

"We have here the following genera of blood-sucking Muscidæ occurring fairly commonly: *Stomoxys*, *Lyperosia*, *Philæmatomyia* and *Hæmatobia*.

"Of these all save *Stomoxys* breed habitually in cowdung, but this rarely if ever breeds there but chooses fermenting vegetable stuff such as heaps of fodder or decaying grass.

Save in certain districts such as Assam (I have not been there but have heard that they bite people freely in some parts), I should say the risk of infection from their bite was less here than in England, for though the flies are often very common they seem to bite much less often than, for instance, at my home in Norfolk, England. Why this should be I have no idea, but it is certainly true for Pusa and several other districts where the flies are quite common. Possibly the humidity-conditions may have something to do with it. It is, of course, for most of the year comparatively or very dry over a large part of India."

Gravely [3] gives some interesting facts concerning some flies asso-

[1] Bull. Soc. Ent. Ital. XXXIX, p. 92 (1907).

[2] Ann. Mus. Zoöl. Acad. Imp. Sci. St. Petersburg, Vol. 17, p. 630 (1913).

[3] Rec. Indian Mus., Vol. 6, pp. 44–5 (1911).

ciated with cattle in the vicinity of Calcutta. He states that *S. calcitrans* together with *S. indica* Pic. (*limbata* Austen) occurred commonly on cattle during the day, but not at night, while *Philamatomyia insignis* Austen was the most common blood-sucking Muscid on these animals.

Ceylon.—Brunetti [1] has mentioned the occurrence of *Stomoxys calcitrans* at Colombo, Ceylon, and it was recorded from Ceylon also by Schiner [2] at a much earlier date.

Siam.—Recorded by Austen (loc. cit.) on the basis of specimens in the British Museum.

China.—Howard [3] refers to the occurrence of *Stomoxys calcitrans* in China, but gives no further data as to its distribution and relative abundance in that country.

Hong Kong.—It is stated in the Report of the Colonial Veterinary Surgeon at Hong Kong for 1909, according to an abstract in the Experiment Station Record [4] that *Stomoxys calcitrans* and the horn fly are the two most common flies in cattle sheds, both causing cattle a great deal of annoyance.

Many years before Schiner [5] recorded the species from Hong Kong.

Singapore.—Brunetti [6] records *Stomoxys calcitrans* from Singapore.

Japan.—*Stomoxys calcitrans* is evidently a common insect in Japan, as Coquillett [7] found ten specimens in a not very extensive collection of Diptera from Japan. No specific localities are cited in this paper.

Australia

Dr. W. W. Froggatt, the government entomologist to New South Wales, has kindly written in regard to the occurrence of *Stomoxys calcitrans* in Australia that "has a wide range over Australia, though I am not quite sure how far north it ranges."

As early as 1868 it was evidently present at Sydney, N. S. W., as Schiner records it from there in his Diptera of the Novara Reise (p. 311), and the British Museum contains specimens from New South Wales according to Austen (loc. cit.).

Queensland.—Austen records specimens from Queensland in the British Museum (loc. cit.).

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[1] Rec. Indian Mus., Vol. 4, p. 72 (1910).
[2] Novara Reise, p. 311 (1868).
[3] The House Fly—Disease Carrier, p. 243 (1911).
[4] Vol. 22, p. 682 (1910).
[5] Novara Reise, p. 311 (1868).
[6] Rec. Indian Mus., Vol. 4, p. 72 (1910).
[7] Proc. U. S. Nat. Mus., Vol. XXI, p. 333 (1898).

Tasmania

Lea [1] has referred to *Stomoxys calcitrans* as "very common about stables and butchers' shops."

New Zealand

Hutton [2] includes this species in his list of New Zealand Diptera giving Christ church as locality and stating that it is an introduced form "commonly known as the horse fly."

Mr. G. M. Hudson has very kindly written me that "*Stomoxys calcitrans* is rare in New Zealand, though it occasionally enters houses and bites people, especially towards the latter part of summer."

Java

According to Schat,[3] *Stomoxys calcitrans* is common in Java where he regarded it as the chief carrier of surra among cattle. Brunetti [4] also speaks of its occurrence in Javá.

As early as 1868, Schiner records it from Batavia, Java, in his Diptera of the Novara Reise (p. 311).

Sumatra.—*Stomoxys calcitrans* is included by Van der Wulp[5] in his report on Sumatran Diptera.

Philippine Islands

Dr. C. S. Banks, Chief of the Entomological Section of the Bureau of Science in Manila has very kindly furnished some information in regard to the occurrence of *Stomoxys calcitrans* in the Philippines. He writes that it "has been found all over the Philippine Islands up to an altitude of 800 meters (2,500 feet), and may, of course, be found above that, but I am giving data from my experience. It is not what one would call a pest here as it is in parts of the United States, seldom being seen in houses and very rarely biting human beings."

Banks [6] has also referred to it as being abundant at certain seasons in the Philippines, and speaks [7] of its common occurrence in dwellings at Taytay at which place it is also a great annoyance to horses.[8]

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[1] Insect and Fungus Pests of the Orchard and Farm, Hobart, 1908, p. 108.

[2] Trans. New Zealand Inst., 1900, p. 69.

[3] Schat, P. T. Beiträge zu den Untersuchungen über die *Trypanosoma evansi* und zur Bekämpfung der Surra unter dem Hornvieh auf Java. Inaug. diss. Univ. Bern. 1911.

[4] Rec. Indian Mus., Vol. 4, p. 72 (1910).

[5] Midd. Sumatra Exped., p. 43 (1880).

[6] Philippine Journ. Sci. I, p. 1072 (1906).

[7] *Ibid.*, IV, Sec. B, p. 236 (1909).

[8] *Ibid.*, t. c., p. 239.

Hawaii

Van Dine and Norgaard[1] refer to the occurrence of the stable fly in Hawaii, and it was previously listed by Grimshaw in the Fauna Hawaiensis, vol. 3, p. 28. (1901). Austen (loc. cit.) also states that there are specimens from Hawaii in the British Museum.

Summary

The stable fly (*Stomoxys calcitrans*) is one of the most widely distributed insects, rivalling the house fly in this respect. It occurs commonly in parts of every zoölogical region and practically throughout most of them. It is probably native to the palæarctic region from whence it has followed man in his migrations to all parts of the world. In the United States it was common in the vicinity of Philadelphia as early as 1776. It is not equally abundant everywhere that it occurs, but is much more common in temperate regions such as the United States and Argentina. In the tropics it occurs very generally, but almost always in lesser numbers than in cooler climates.

POWDERED ARSENATE OF LEAD AS AN INSECTICIDE

By W. E. Hinds, *Entomologist Agricultural Experiment Station, Auburn, Ala.*

Arsenate of lead was first found to have insecticidal value during the fight against the gypsy moth in Massachusetts about 1893. It was for many years used only in spray applications. The most common form in which it was put upon the market was that of a 50 per cent paste, that is, a paste or putty form which contained practically one half water. The disadvantages of the paste form were numerous. For instance, it necessitated the payment of freight upon one half of a shipment with no insecticidal value. Furthermore, paste stock was liable to dry out and become caked and hard and this drying naturally varied the quantity required to produce a spray solution of given strength and was also more difficult to work up into uniform suspension in water.

Accordingly, after extensive experimentation, several companies of insecticide manufacturers began to put out powdered arsenate of lead a number of years ago and this form of a valuable poison has

[1] Abstract of a Preliminary Report on Insects Affecting Live Stock in Hawaii, Proc. Hawaiian Live Stock Breeders' Assoc., Vol. 5, pp. 19–70 (1908).

become very popular. There is no question that arsenate of lead possesses many advantages over Paris green for most insecticidal uses, and the powdered form has come to be considered as more economical to buy, more convenient to store and to prepare for spraying, than is the paste form. In numerous comparative experiments, insect control from spray made up from powdered arsenate of lead has been just as good as with that made from the paste form.

Here in the South, powdered arsenate of lead has been used very extensively since the fall of 1911 for the control of the cotton worm and is rapidly coming into general use for application for the control of other leaf-eating insects, such as potato beetles. The same method of application as has been used for the cotton worm can be used for applying the powdered arsenate of lead as a dust for many other leaf-eating insects. This method of application by what is called the pole and bag outfit, as fully described in *Alabama Bulletin No. 164*, requires no expensive outfit and gives very rapid and convenient distribution to the poison.

In Alabama and Mississippi in the fall of 1911 at least 500,000 pounds of the powdered material were distributed for use in cotton-worm control. Many cotton planters started the fight against the worms with dust applications of Paris green. In many cases, however, the Paris green caused sores, both upon men and animals engaged in the application and workmen frequently refused to continue the work if obliged to use Paris green. Many of these same planters then turned to powdered arsenate of lead and continued their fight against the cotton worm with highly satisfactory results. In all the work that was done in Alabama with powdered arsenate of lead, we have yet to hear of a single sore from it upon either man or animal engaged in its application, or of a single case of internal poisoning resulting from this extensive use.

Publicity is given to the foregoing note at this time because of the fact that, during the past summer, certain parties have been scattering broadcast circular matter announcing in substance such grave danger of fatal poisoning from the use of powdered arsenate of lead that its manufacture and distribution ought to be prohibited by law. The parties from whom we received this circular matter are known to us as extensive manufacturers of another form of insecticide. Definite information regarding authentic cases of injurious effects from the use of powdered arsenate of lead were at once requested from the parties issuing the warning, but, during the several months that have elapsed meantime, not a word has been received from them.

This statement is issued in the hope that those who may have need to use any arsenical insecticide may not be misled. If there were real

danger in the use of powdered arsenate of lead, we would by all means seek to learn the truth and to inform the public accordingly. At the present time we know of no reason why anyone should hesitate to use powdered arsenate of lead in preference to Paris green or any other arsenical poison now commonly obtainable on the market.

The department of entomology of the Alabama Experiment Station is now making an investigation covering the use of various forms of arsenate of lead with a view to finding exactly what form is most effective, economical and generally satisfactory, for use with various insect pests, and we believe that this work will in the future be of real service, not only to the planters who may use these poisons but to the manufacturers as well.

THE WILT DISEASE OF GIPSY MOTH CATERPILLARS[1]

By R. W. Glaser and J. W. Chapman, *Bureau of Entomology*

Introduction

In August, 1912, we published a paper in *Science* entitled: "Studies on the Wilt Disease or Flacherie of the Gipsy Moth." More extensive observations and experiments conducted during the past year have led the authors to modify some of their original views concerning this disease. The work last year was carried on under rather unfavorable circumstances making elaborate experiments impossible. This difficulty was overcome through the courtesy of the Bureau of Entomology who supplied us with all of the necessary help and material.

Our observations in 1912 on the general behavior of the disease as influenced by external conditions, conclusions concerning the mode of infection and studies on the general pathology were on the whole correct, as far as they went, but a large series of experiments performed during the past summer have shown that we were too hasty in connecting etiologically a micrococcus with the disease.

Gyrococcus flaccidifex and the Blood Test

We described this micro- or diplococcus last year (1912) and believed it to be etiologically connected with the wilt disease. Since then it has proved to be simply a casual intestinal parasite in nature with which much of our laboratory material became infected. This micrococcus was isolated in pure culture and caterpillars inoculated or fed with it died of wilt after a comparatively short time. Our

[1]This will be followed by a bulletin of the Bureau of Entomology in which this disease will be treated more fully.

only explanation for this phenomenon at present is, that the caterpillars we thought healthy and used for the inoculation experiments were really infected with the virus and by giving them great quantities of this bacterium, we simply lowered their resistance to the disease and hastened death, which, in all probability, would have occurred sooner or later anyway. Another matter not to be overlooked is the apparent great resistance of many caterpillars towards the virus, provided other invaders or unfavorable conditions are excluded. The caterpillars used in the control experiments in 1912 did not die although doubtless some of them were infected, and the only feasible explanation for this seems to be that in one case, *i. e.*, in the inoculation experiments, the introduction of great quantities of a specific bacterium lowered the resistance of the animals towards the virus and death followed while in the other case, *i. e.*, in the controls no such bacterium was introduced.

Observations made on the blood of a great many individuals followed by a study of their tissues in section have clearly demonstrated that the polyhedral test for diagnosing the health of caterpillars is by no means absolutely reliable. The blood corpuscles of a caterpillar may not reveal polyhedral bodies, but this does not necessarily mean that the caterpillar is healthy, for sections through such an individual are very likely to show polyhedral bodies in the nuclei of the tissue cells. On the other hand polyhedral bodies may be present in the blood corpuscles and not in the tissues. These observations showed the futility of the blood test in diagnosing. It is a pity that it cannot be used for we have been compelled to substitute a rather more indefinite for a presumably more definite method.

Why Gyrococcus Was Eliminated

The reasons why we abandoned *Gyrococcus flaccidifex* are the following: If smears are made from caterpillars dead but a short time no bacteria can be found as a rule. Cultures made from such caterpillars on caterpillar and the ordinary nutrient media remained sterile, except in a very few cases when the bacterium in question again appeared. Of course, after a caterpillar has been dead for a certain length of time bacterial invaders entered the body, but cultures made from dying or freshly dead caterpillars rarely manifested growth. At the beginning when the disease first became epidemic in nature we made smears and cultures out in the field by taking with us all the necessary sterilization appliances and in so doing on quiet windless days we found the chances for contamination were very slight as compared with those in our laboratory where thousands of caterpillars had previously died.

As stated in our first paper dead caterpillars cannot be sectioned owing to the fact that they disintegrate completely after death. If serial sections are made of diseased caterpillars obtained in the field, polyhedral bodies will be found in abundance, but no bacteria in the tissues and in most cases the intestinal lumen will be perfectly free from microörganisms in general. This is a very striking fact when compared with the abundance of intestinal flora in the higher animals. Last year we stated that we had observed small wriggling things in the tissues which after being stained were revealed as Gyrococci. Small wriggling or rather dancing things are certainly found in the tissues of diseased caterpillars, and it is possible that we mistook these for Gyrococci. Pigment granules are also easily confused with bacteria as anyone knows who has studied the pigment granules in the basement membrane lining the hypodermis, and in the ganglia. The microörganism described as *Gyrococcus flaccidifex* when found proves to be an intestinal invader pure and simple. We will return to the small wriggling particles later.

Methods Used for Obtaining Healthy Material

After we realized that it was futile to depend upon the blood test for obtaining healthy material and that it was impossible to be certain of any material in the vicinity of the laboratory, field men were asked to report any places in the infested territory where the disease was not evident. As soon as such places were reported, we visited and carefully examined them ourselves. If any dead caterpillars were found and later on microscopical examination showed polyhedral bodies, living material from such a locality was not used. Caterpillars were only taken from places where the disease could not be found at the time of collection. The objection will at once be raised and rightly, that the disease may have been there in a latent form and that no one can tell by an external examination whether a caterpillar is healthy or not. We have studied the disease in the field as well as in the laboratory and have found it in all of the infested territory from Maine to Rhode Island. It will at once become evident what a difficult matter it is to obtain healthy material for experiments. Apparently the healthiest looking colonies harbor a number of diseased individuals, for sooner or later, if the place be carefully watched, the disease will appear. Then after all, the critic will say, you obtained your experimental material from a diseased locality. This is quite true, but the disease if present had not taken the form of an epidemic in such localities when the collections were made and the chances of obtaining some healthy individuals were very great. In places where the infestation is light and the caterpillars widely separated, the disease never reaches

an epidemic form throughout the entire summer and naturally many caterpillars escape since infection can probably only take place through the mouth by means of the food. Dead caterpillars disintegrate and their fluids soil the leaves, and other caterpillars on eating these become infected. Some experiments, to be mentioned later, seemed to show that this is the only way infection can occur. It at once becomes apparent why the disease plays such havoc in a heavily infested locality.

After being collected from a certain place some of the caterpillars were isolated in separate autoclaved boxes and placed in rooms which had never been used for this purpose. Others were kept together in what were known as stock boxes. Since it has, we believe, been accepted that unfavorable conditions assist the development of the disease, provided infection has occurred, the individuals in the different stock boxes were treated in a variety of ways. Some were starved, others were subjected to the heat of the sun, still others were fed with leaves soaked in water for forty-eight hours. After several days in case no disease appeared in either the isolated boxes or in those thus treated, it was thought safe to use them for the experiments. Several times during such health tests one or more caterpillars would contract the disease and then the entire collection was thrown away, the boxes were again autoclaved, and another lot brought in to be submitted to a similar physical examination. Such a method of obtaining healthy individuals proves to be much more satisfactory than the blood test as our controls show and if large enough numbers are used is perfectly safe. It was only owing to the large series of experiments which we performed as will be seen from our next publication that we were able to come to any conclusions at all concerning the virus of the wilt disease.

Exciting Agents Thought to Be Responsible for the Disease

A disease very similar to the wilt disease of the gipsy moth is known to attack the silkworm and the nun moth in Germany. In this country we have another similar disease in our two species of tent caterpillars, *Malacosoma disstria* and *M. americana.*

In Europe there is a tendency to group all of the caterpillar diseases which are characterized by the formation of polyhedral bodies under the name of "polyederkrankheit" or polyhedral diseases. This is an excellent way to distinguish them from those diseases not characterized by the formation of such bodies for, though we do not believe that the polyhedral bodies are the exciting cause of the disease, we are convinced, nevertheless, that they are absolutely specific for a certain type of malady.

European investigators have advanced various theories concerning the exciting cause of the polyhedral diseases. At one time bacteria were thought to be responsible, especially by Hofmann and Tubeuf. The polyhedral bodies were regarded as being formed by the tissue cells as a reaction against the bacterial toxins. In 1911 Escherich and Miyajima expressed the opinion that we must look upon the polyhedral bodies as the carriers of the virus. Bolle at one time believed a certain Microsporidian (*Microsporidium bombycis*) to be responsible for the disease. According to Prowazek's latest paper in 1912, on the "Gelbsucht" of the silkworm, Knoch delivered a lecture in Stuttgart on the 14th of March, 1912, in which he said that little refractive granules appear in the blood corpuscles. These multiply and infect the nuclei of tissue cells where their amoeboid membrane hardens and they change into polyhedral bodies. He further said that the minute granules which resemble the Chlamydozoa of Prowazek are the vegetative; the polyhedral bodies the resting stages of the causative organism.

Prowazek, in the paper above mentioned, infected some fifteen or sixteen caterpillars with emulsified diseased material which he passed with difficulty through the Berkefeld and through his Agar-Ultra filter. The filtrate contained no polyhedral bodies and no bacteria, as control cultures showed. The caterpillars died typically and so he concluded that in some cases healthy caterpillars could be infected with material free from polyhedra. These experiments are suggestive, but cannot be taken seriously because no controls were used and because the blood test was the only precaution taken in diagnosing the health of caterpillars.

The Exciting Cause of the Wilt Disease a Filterable Virus

Thirty filterable viruses are now known to be responsible for certain infectious diseases in man and the lower mammals, but to our knowledge only one has been described in insects, namely that of Sacbrood, a bee disease discovered by White in 1913.

In our infection experiments last year, we obtained negative results with the material passed through the Berkefeld filter. This was due to the fact that the material was so concentrated that a slimy film was deposited on the outside of the candle and withheld the virus. A concentrated emulsion of diseased material is so full of polyhedral bodies, cellular débris, hairs and pigment granules that it very soon plugs up the pores of the filters. This year caterpillars, which died typically of the disease, were crushed with just enough sterile water to facilitate the crushing. This material was then strained through cheese cloth and filtered by means of suction through filter paper. The filtrate was diluted in one case with fifty, in another with twenty-

five times its volume of sterile water. This was then passed through a Berkefeld "Grade N" filter and used for the infection experiments. The filtrate was sterile in so far as bacteria were concerned as control cultures on nutrient agar, gelatine and caterpillar soup showed. Microscopical examination showed no polyhedral bodies. Nothing could be observed even in a dark field except some very minute dancing granules also noticed by Prowazek in his experiments with silkworms (p. 272). These little granules may be identical with those observed in diseased tissue mentioned in the first part of this paper. This matter, however, is still so indefinite that speculation seems to be useless, but, since they were never found in the tissues of healthy caterpillars, their presence is worth recording.

A large number of caterpillars were fed with the Berkefeld filtrate smeared on red oak leaves. In order to establish uniformity in the experiments, all caterpillars of the same series were kept in one room where they could be subjected to the same degree of heat and humidity. Each caterpillar was kept in a sterilized pasteboard tray by itself, and fed with fresh red oak leaves after the infected leaves had been partially eaten. The oak leaves all came from a vicinity which was not infested with caterpillars. Thus the possibility of bringing the infection from the outside into the laboratory was excluded. Another matter considered was the age of caterpillars used in these experiments. If caterpillars are near the pupal stage, they cease feeding and are, therefore, difficult to infect, so it is important to get them young enough so that they will be sure to feed.

In one series of experiments fifty caterpillars were fed with the Berkefeld filtrate, in another forty, in a third twenty. The same number was fed with material before it was passed through such a filter and a large set of controls fed with Berkefeld filtrate which had been sterilized by autoclaving accompanied each series.

Out of the entire lot of caterpillars (110) fed with the unsterilized Berkefeld filtrate, twenty-eight died with typical wilt symptoms. Microscopical examination showed polyhedral bodies to be present in abundance and stained smears and cultures in nutrient broth showed that bacteria had taken no part. Quite a few of the caterpillars died of another cause which we will discuss more in detail at another time. Suffice it to say that the extreme heat during July of the past summer had much to do with the death of a great many of the caterpillars. Their death was due to disturbances in the normal physiological functions and not due to infectious disease. Caterpillars dying from this cause were not very flaccid, their skin was tough; they were not disintegrated, but more or less dried out. Polyhedral bodies were not present, but usually a great many crystals with radiating lines could

be found, a sign of some metabolic disturbance. Quite a few larvæ were killed by the imported tachinid parasite, *Compsilura concinnata*, and the rest transformed into moths. The only way we can account for these moths is on the supposition that they arose from immune caterpillars or from such as had escaped infection in some way. A greater number of caterpillars (48 out of 85) died in the experiments with unfiltered virus. This seems to show that the organism is filterable but with difficulty. The filter became clogged up after a short time and, therefore, only a certain amount of the virus could pass through it and, in order to overcome this difficulty in part, the old filters were replaced by new ones every few minutes. Among the entire number of controls, 162 caterpillars, only three died of wilt. This is equivalent to about 1.8 per cent, a very small percentage and one which can almost be overlooked as an experimental error in such a large set of controls when compared with the numbers that died in the experiments. In the controls as well as in the stock trays a great number of caterpillars died of the physiological cause already mentioned. Especially significant are those which died of this cause in the stock trays for these caterpillars were not at all infected, so that it is impossible to attribute the death-rate in the controls to some toxic effect of the sterilized virus. Laboratory conditions are poor at the best and our records show that very high temperatures were probably responsible for this "physiological death" as we have called it. In the laboratory, especially during high temperatures, the food plants put into trays dry out rapidly, no matter how often they are renewed. Dew and rain cannot wet them and very likely the lack of water, in other words thirst, was responsible for the mortality. We did not care to dampen the leaves artificially very much for fear that we might produce a condition still more unnatural and one that might favor the development of moulds in the trays.

The polyhedral bodies have as yet revealed nothing of a parasitic nature. They may, of course, be a resting stage of a filterable vegetative form, but we are rather inclined to regard them as reaction bodies. They are possibly products of nuclear digestion produced by the virus invading the nuclei and digesting the chromatin.

We should like briefly to consider one more matter. It is claimed in this country, notably by Mr. William Reiff, that the disease is air borne and that caterpillars can be infected in the woods by hanging out small cheese-cloth bags containing the remains of individuals that have died of the disease. With this point in view we arranged a set of boxes near some windows through which the wind blew steadily for over ten days. The boxes were closed except on two sides, namely the side facing the window and the side facing the interior of the room.

These were simply covered with cheese cloth through which the wind could blow. Two boxes were placed in each of three windows, and twenty caterpillars, were placed in each with an abundance of red oak leaves. To the windward of one box a little bag of material was hung prepared according to Reiff's receipt. The cheese cloth lining the windward side of another box was smeared with the juices of disintegrated caterpillars. The leaves in two boxes were smeared with the same juices and the two remaining boxes were kept as controls.

Twenty-one caterpillars died of the disease in the two boxes containing leaves smeared with the virus and one died in each of the control boxes. Two died in the box to the windward of which the bag was hung and three in the box lined with the smeared cheese cloth. In the experiment with the bag one died the day after the experiment was begun, so in all probability it had already been infected before being placed in the box, for one day is entirely too short an incubation period. In this same box four died of tachinid parasitism; all the rest transformed. In the controls three died of tachinid parasitism and the rest transformed. In the boxes in which the leaves were smeared four died of tachinid parasitism and the rest transformed.

While these experiments are not very extensive they, nevertheless, indicate that the wind is an unimportant factor in the rapid spread of the disease and that infection in nature occurs when caterpillars feed on leaves soiled by the juices of dead individuals. During the height of the season we found leaves everywhere with brown spots on them and, on making smears of such spots with some sterile water, polyhedral bodies were found in great abundance.

A very striking phenomenon observed in all of our experiments was the large number of moths obtained from caterpillars infected several times, both with the Berkefeld filtrate and with the unfiltered virus. This seems to us to be very suggestive of immunity and agrees with observations in the field where, in a given locality, the disease raged for several weeks and yet moths were later seen in abundance. They may have been fortunate enough to escape infection, but this seems improbable in a heavily infested area and was entirely impossible in the laboratory where they were infected several times.

Summary

Our experiments and observations may be summed up as follows:

1. The presence of polyhedral bodies in the blood corpuscles may be useful in diagnosing the health of nun moth caterpillars, but this test cannot be used for gipsy moth caterpillars with any degree of certainty.
2. The virus of the wilt disease is filterable with difficulty.
3. Such a filtrate is free from bacteria and polyhedral bodies.

4. Caterpillars dead from infection with the filtered virus are flaccid, completely disintegrated and full of polyhedral bodies.

5. Usually the complete absence of bacteria immediately after death is very striking as cultures and smears show.

6. Minute dancing granules were observed in the diseased tissue cells with very high powers.

7. These same granules were also noticed in the Berkefeld filtrate.

8. There is no evidence that the polyhedral bodies are stages of the filterable virus.

9. A large number of caterpillars used in the experiments died, due to disturbances in their normal physiological activities.

10. There is no evidence that the wind is an important factor in distributing the disease.

11. Infection naturally takes place through the mouth by means of the food.

12. Apparent immunity is a striking phenomenon.

Conclusion

In conclusion we wish to thank Professor William Morton Wheeler for the interest which he showed during the progress of our experiments. We also wish to thank Mr. A. F. Burgess, director of the Gipsy Moth Laboratory at Melrose Highlands, for the kindly coöperation which he has given us. Had he not provided efficient assistants to aid in feeding and looking after the trays, it would have been impossible to have accomplished much. We wish further to thank Miss Teresa Sheerin, one of our assistants, whose conscientious work and interest aided materially in our researches. Last, but not least, we would like to express our thanks to all the field men who assisted in this work.

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ARTHROCNODAX CAROLINA N. SP.

By E. P. Felt, *Albany, N. Y.*

The species described below is allied to *A. apiphila* Felt from which it is easily separated by the lighter circumfili and the longer stems of the antennal segments in the male. It is easily separated from *A. occidentalis* Felt, a species recorded as preying upon red spider in California, by the shorter stems of the antennal segments in the male and by the rounded ventral plate. Mr. E. A. MacGregor, who reared this species in both 1912 and 1913 from red spider on cotton, is of the opinion that it is the most important natural agent in controlling this pest.

Male. Length .75 mm. Antennæ about as long as the body, sparsely haired, light brown; 14 segments, the fifth having the two parts of the stems with a length three-fourths and one and three-fourths times their diameters, respectively. The

circumfili are normally developed and not unusually thick or heavy. Mesonotum dark reddish brown. Scutellum and postscutellum yellowish. Abdomen yellowish brown. Halteres, coxæ and femora basally yellowish or pale straw, the distal portion of femora, tibiæ and tarsi slightly darker; claws slender, strongly curved, simple; pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, stout, terminal clasp segment long, tapering; dorsal plate long, broad, deeply and triangularly emarginate, ventral plate short, broadly rounded.

Female. Length .75 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a stem one-fifth the length of the cylindric basal enlargement, which latter has a length a little over twice its diameter and sparse whorls of stout setæ basally and apically; terminal segment slightly produced, with a length over thrice its diameter, broadly rounded apically. Palpi; the third segment with a length about two and a half times its diameter, narrowly oval, the fourth segment one-fourth longer than the third, more slender. Color nearly as in the male, except that the thorax and abdomen are more orange. Ovipositor short, the terminal lobes narrowly oval and thickly setose. Color characters from microscopic preparations and, therefore, of only approximate value. Type Cecid. a2461.

Lepidoptera Breeding on Evening Primrose. Last year I found an interesting large-flowered evening primrose (*Oenothera hewetti* Ckll., Proc. Biol. Soc. Wash., XXVI, p. 203) in New Mexico, and secured a living plant for my garden at Boulder, Colorado. This plant, in the summer of 1913, grew to a very large size, and furnished the material from which the species was described. When gathering the seeds, I removed large numbers of whole pods, to save time, and presently (October) found that many small moths were issuing from them Most of these were *Mompha brevivittella* Clemens, but several were strongly marked with white, and belonged to *Mompha circumscriptella* Zeller. Although the moths were so abundant, they did not prevent me from getting enough seed to supply all my correspondents interested in *Oenothera*. It must be considered doubtful whether they are really injurious, since the normal crop of seed is enormously greater than would be required for the prosperity of the plant, supposing only a small fraction to grow. A third *Mompha*, *M. pecosella* Busck, has been found by me on the University Campus at Boulder, but it has not been bred. I am indebted to my kind friend Mr. Aug. Busck for the determination of all the moths. He tells me that at Dallas, Texas, Mr. W. D. Pierce bred *M. circumsciptella* from *Galpinsia hartwegi*. Doubtless the species of *Mompha* feed on various evening primroses, and presumably the common native host of those attacking *Oe. hewetti* in my garden is our very abundant *Oe. cockerelli* Bartlett in de Vries, 1913.

T. D. A. Cockerell.

Correction

Chinch Bug Egg Parasite. There seems to have been a somewhat ambiguous and unsatisfactory statement edited into the scientific note appearing on pages 425–26. The original stated in effect that Mr. A. B. Gahan (who will describe the species) concluded that the parasite represented a new genus and species of the Proctotrypidæ, a finding confirmed by Mr. Crawford of the United States National Museum.

E. P. Felt.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

Nearly seven years have elapsed since the economic entomologists assembled at New Orleans. They have been years of progress and prosperity, at least so far as entomological developments in the southern part of the country are concerned. The Atlanta gathering will be largely attended by southern entomologists, and the investigator located in the north will have at this meeting a most excellent opportunity of talking with the men who are doing things in the warmer sections of this country, and through them obtain a better idea of their special problems. Entomologists at a distance are strongly urged to make an effort to be present and take part in a meeting which promises to be one of the most successful of recent years.

The stable fly, formerly held as a comparatively innocuous insect, stands convicted as a carrier of infantile paralysis and now the finger of suspicion[1] has been pointed at it in connection with the mysterious Pellagra, an infection which some have thought might be carried by species of Simulium. American investigations of this latter genus have failed to produce conclusive evidence of complicity on the part of Simulium, and it now remains to be seen if this latest arraignment will be followed by indictment. There is still much to be learned concerning the Diptera and it is to be hoped that the interest aroused in the groups containing pathogenic forms will be extended and result in studies of the numerous unknown flies and the bringing of our knowledge concerning the order up to a state comparable to that relating to the Coleoptera, Lepidoptera or Hymenoptera.

[1] 1913, Jennings, A. H. and King, W. V. Amer. Jour. Med. Sci., 146:411. (Separate p. 1–30.)

Current Notes

Conducted by the Associate Editor

Alfred Russell Wallace died November 7, in the ninety-first year of his age.

A new insectary is being erected at Oklahoma College and Station.

A new nursery inspection law has been enacted by the legislature of Rhode Island.

Mr. J. W. Jeffrey, formerly State Horticultural Commissioner of California, is now engaged in organizing fruit growers' associations in that state.

Professor S. A. Beach, Professor of Horticulture at the Iowa Agricultural College, recently visited the orchard regions of Utah and the Pacific Coast.

Mr. U. C. Loftin has resigned as assistant in entomology at the Florida University and Station, to accept a position in the Bureau of Entomology.

Mr. W. W. Marshall of Nelsonville, Ohio, has accepted a position with the State Entomologist's office at College Station, Texas, with the rank of assistant entomologist. Mr. Marshall will assume the duties of his position on December 1.

Mr. Frank E. Lutz and Mr. Charles W. Leng have recently returned from an entomological collecting trip to Cuba, in the interests of the American Museum of Natural History of New York City.

Dr. O. M. Reuter, formerly Professor of Zoölogy in the University of Helsingfors, Russia, and an authority in Hemiptera-Heteroptera, died September 2, aged sixty-three.

Mr. Gordon W. Ells, B. S., a graduate in the class of 1913, Massachusetts Agricultural College, has been appointed assistant entomologist at the Agricultural Experiment Station, Auburn, Ala.

At Smith College, Northampton, Mass., a new biological hall is being erected in which the department of zoölogy and botany will be situated. The trustees have appropriated $140,000 for the new building.

Dr. Robert Matheson has resigned as Provincial Entomologist of the Province of Nova Scotia, to accept the position of investigator in entomology in the Cornell Agricultural Experiment Station, Ithaca, N. Y.

Mr. R. H. Van Zwanlenburg, B. S., a graduate of the Massachusetts Agricultural College, class of 1913, has been appointed entomologist of the Federal Agricultural Experiment Station at Mayaguez, Porto Rico, in place of the late Dr. C. W. Hooker.

An apiary inspection law was passed by the state legislature of Arizona at its last session. The law became effective on July 5, and the governor has appointed Mr. J. P. Ivy as state inspector.

Mr. H. S. Smith, superintendent of the California State Insectary, was sent in August for a two or three months' trip to the Orient, in search of the natural enemies of the various scale insects attacking citrus fruits in California.

The Extension Department of the Agricultural and Mechanical College of Texas is offering correspondence courses in "Elementary Entomology" and "Economic Entomology." The work is in coöperation with the Entomological Department of the college and is under the supervision of Professor Wilmon Newell.

Mr. William Moore of Cornell University, who for the past three years has been in South Africa, has accepted a position in the Entomological Division, Agricultural College, University of Minnesota, and has charge of the Section of Truck Crop and Greenhouse Insects and of the Insectary of the Division.

Mr. Leroy Childs, field assistant of the Bureau of Plant Industry, United States Department of Agriculture, and a graduate of Leland Stanford University, class of 1913, has recently been appointed assistant secretary of the California State Horticultural Commission.

Mr. Sherman W. Bilsing, formerly Fellow in the Department of Zoölogy and Entomology at the Ohio State University, has been appointed to the position of instructor in entomology at the A. & M. College of Texas. Mr. Bilsing assumed the duties of his new position on August 15.

Dr. P. R. Uhler, author of many papers on Hemiptera, died October 21, at the age of seventy-eight. Dr. Uhler described many American species of insects, especially Hemiptera; for twenty-two years he has been provost of the Peabody Institute at Baltimore.

H. M. Russell, after an absence of a few months on furlough, has returned to continue his work with the Bureau of Entomology. He is now in the Salt River Valley of Arizona, engaged in sugar beet leaf hopper investigations. Address, Office of the State Entomologist, Phoenix, Ariz.

Messrs. E. W. Laake and L. J. Bower, recent graduates of the Texas Agricultural College, have accepted positions in the Bureau of Entomology. Mr. Bower is at present located at the Bureau laboratory at Wellington, Kan., and Mr. Laake is engaged in the boll-weevil investigations at the Bureau laboratory in Dallas, Texas.

Benjamin W. Douglass, formerly state entomologist of Indiana, is entomological expert, and Frank Wallace, formerly assistant state entomologist, is secretary and treasurer, of the State Forestry Company, Indianapolis, Ind., a company formed to do business in landscape gardening, tree surgery, and to give advice in all horticultural matters.

Dr. J. F. Illingworth, professor of entomology in the College of Hawaii, spent three months in the Fiji Islands during the past summer. He went in the interest of the Colonial Sugar Refining Company, taking down a large colony of the Tachinid flies, which have proved such effective parasites of the sugar-cane borer in the Hawaiian Islands. The flies did splendidly in the cages in Fiji and a number of good sized colonies were liberated in the infested districts.

The State Horticultural Commission of California has recently placed a quarantine on the states of Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, Tennessee, Kentucky, Ohio, Michigan, Illinios, Kansas, Arkansas, Nevada, and Florida, on account of the diseases known as "Peach Yellows" and "Contagious Peach Rosette."

Mr. Alfred B. Champlain, assistant in the Division of Economic Zoölogy, Department of Agriculture, Harrisburg, Pa., resigned September 1, to accept a similar position in the Bureau of Entomology of the United States Department of Agriculture, Washington, D. C. He will work on forest insect investigations under Dr. A. D. Hopkins, and is soon to travel through Colorado, Arizona and New Mexico, studying forest insect conditions there.

Mailed December 15, 1913

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Drawn from Actual Photograph taken at Melrose, Mass. TREE TANGLEFOOT saved the tree on the left, Gypsy Moths stripped the tree on the right

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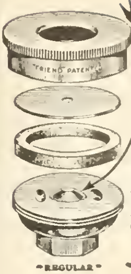

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